

IN THE UNITED STATES DISTRICT COURT FOR THE  
NORTHERN DISTRICT OF OKLAHOMA

W. A. DREW EDMONDSON, in his )  
capacity as ATTORNEY GENERAL )  
OF THE STATE OF OKLAHOMA and )  
OKLAHOMA SECRETARY OF THE )  
ENVIRONMENT C. MILES TOLBERT, )  
in his capacity as the )  
TRUSTEE FOR NATURAL RESOURCES )  
FOR THE STATE OF OKLAHOMA, )

Plaintiff, )

vs. )

4:05-CV-00329-TCK-SAJ

TYSON FOODS, INC., et al, )

Defendants. )

-----

VOLUME I OF THE VIDEOTAPED  
DEPOSITION OF FRANK COALE, PhD, produced as a  
witness on behalf of the Plaintiff in the above  
styled and numbered cause, taken on the 15th day of  
January, 2009, in the City of Tulsa, County of  
Tulsa, State of Oklahoma, before me, Lisa A.  
Steinmeyer, a Certified Shorthand Reporter, duly  
certified under and by virtue of the laws of the  
State of Oklahoma.

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25

# A P P E A R A N C E S

FOR THE PLAINTIFFS: Mr. Robert Nance  
Attorney at Law  
502 West 6th Street  
Tulsa, OK 74119  
-and-  
Mr. Trevor Hammons  
Asst. Attorney General  
313 N.E. 21st Street  
Oklahoma City, OK 73105

FOR CARGILL: Ms. Theresa Hill  
Attorney at Law  
100 West 5th Street  
Suite 400  
Tulsa, OK 74103

FOR SIMMONS FOODS: Mr. John Elrod  
Attorney at Law  
211 East Dickson Street  
Fayetteville, AR 72701

FOR PETERSON FARMS: Mr. Scott McDaniel  
Attorney at Law  
320 South Boston  
Suite 700  
Tulsa, OK 74103

FOR GEORGE'S: Ms. K. C. Tucker  
Attorney at Law  
221 North College  
Fayetteville, AR 72701

FOR CAL-MAINE: Mr. Robert Sanders  
Attorney at Law  
2000 AmSouth Plaza  
P. O. Box 23059  
Jackson, MS 39225  
(Via phone)

2

(Whereupon, the deposition began at  
9:04 a.m.)

VIDEOGRAPHER: We are now on the Record for  
the deposition of Dr. Frank Coale. Today is January  
15th, 2009. The time is 9:05 a.m. Would counsel 09:04AM  
please identify themselves for the Record?

MR. NANCE: Bob Nance for the State of  
Oklahoma.

MR. HAMMONS: Trevor Hammons for the State  
of Oklahoma. 09:04AM

MR. HAMMONS: For the State of Oklahoma.

MR. McDANIEL: Scott McDaniel for Peterson  
Farms, Inc.

MS. TUCKER: K. C. Tucker for the George's  
defendants. 09:04AM

MR. ELROD: John Elrod for Simmons.

MS. HILL: Theresa Hill for Cargill, Inc.,  
Cargill Turkey Production, LLC.

VIDEOGRAPHER: And on the phone?

MR. SANDERS: Bob Sanders for the Cal-Maine 09:04AM  
defendants.

VIDEOGRAPHER: Thank you. The witness may  
be sworn in.

FRANK COALE, PhD  
having first been duly sworn to testify the truth,

4

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25

# I N D E X

W I T N E S S P A G E

FRANK COALE, PhD

Direct Examination by Mr. Nance 5

Signature Page 252  
Reporter's Certificate 253

3

the whole truth and nothing but the truth, testified  
as follows:

## DIRECT EXAMINATION

BY MR. NANCE:

**Q Dr. Coale, would you state your name for the 09:05AM  
court and jury, please?**

A Frank Coale.

**Q And how are you employed, sir?**

A I'm a professor at the University of Maryland.

**Q And what is it you teach at the University of 09:05AM  
Maryland?**

A I'm a soil scientist, and most recently I've  
been teaching environmental science courses.

**Q This is your first deposition in this case; 09:05AM  
correct?**

A First deposition ever, yes.

**Q Ever?**

A Yes.

**Q But you've testified once at the preliminary 09:05AM  
hearing, preliminary injunction hearing in this  
case; is that right?**

A Yes.

**Q Have you reviewed your testimony in that  
hearing prior to being here today?**

A Yes, I have. 09:05AM

5

1 Q Are you satisfied with the testimony you gave?

2 A Yes.

3 Q Okay. How long have you been at the  
4 University of Maryland?

5 A Fifteen years. 09:05AM

6 Q Okay. Have you had occasion to be involved in  
7 the study of agriculture on the Delmarva Peninsula?

8 A Yes, I have.

9 Q Give me the 30,000-foot overview of that.

10 A The 30,000-foot overview of my work has been 09:06AM  
11 looking at agronomic soil fertility issues, nutrient  
12 management issues, the interface between  
13 agricultural production and water quality concerns.

14 Q Okay. What is the relationship between  
15 agricultural production and water quality concerns 09:06AM  
16 in the Delmarva Peninsula?

17 A Well, the goal is to manage nutrients on the  
18 farm so that the farm has -- the soil has enough  
19 nutrients in it to produce maximum crop production  
20 that the farmer -- whatever crop the farmer is 09:06AM  
21 growing and yet try to minimize the loss from that  
22 farmland of nutrients into surrounding water bodies.

23 Q Is there a water quality problem in the  
24 Delmarva Peninsula caused in part by agricultural  
25 production? 09:06AM

6

1 A Water quality problem surrounding the Delmarva  
2 Peninsula?

3 Q Right.

4 A You know, the Chesapeake Bay is a focus area,  
5 which that area is -- there's a lot of agricultural 09:07AM  
6 land around that area, and the waters of Chesapeake  
7 Bay are enriched with nutrients above levels that  
8 the water quality specialists think they should be.

9 Q Okay.

10 A And so there's a relation because of landscape 09:07AM  
11 proximity.

12 Q Okay. When in your career did you first have  
13 any discussion with any employee of the defendants  
14 in this case about those kind of issues, meaning  
15 agriculture and water quality issues? 09:07AM

16 A In this case?

17 Q They're probably listed on the caption if you  
18 need to look.

19 A The first -- my first knowledge of this case  
20 was -- it was November or December of 2006. 09:07AM

21 Q Okay. Perhaps I wasn't clear. Look at the  
22 caption and see who the defendants are in this case.  
23 Have you dealt with any of their employees in the  
24 Delmarva Peninsula prior to 2006 or 2007?

25 A I don't believe so. 09:08AM

7

Q Do they have any presence -- do these  
defendants have any presence in the Delmarva  
Peninsula?

A Not that I know of.

Q Okay. Then that brings us to this case. When 09:08AM  
was it you were approached about being involved in  
this case?

A It was November or December of 2006.

Q And who approached you, sir?

A I believe the initial phone call came from Mr. 09:08AM  
Webster.

Q I don't know Mr. Webster. Who does he work  
for?

A That's a very good question. We met at an  
office of Sidley Austin in Washington, D.C. I 09:08AM  
presume.

Q Is he a lawyer at Sidley Austin?

A I think so. My guess would be yes.

Q Tell me about that meeting at Sidley Austin.

A They asked if I could come meet with them to 09:09AM  
talk about nutrient management issues in general and  
agricultural and nutrient issues. At that time I  
didn't know where things were going. I didn't have  
any background information. We met for several  
hours and my -- what I remember about it was, I 09:09AM

8

think they were basically trying to see whether my  
expertise had some relationship with the case they  
were working on developing.

Q Did you meet with anyone besides Mr. Webster?

A I believe at that meeting was a Mr. 09:09AM  
Fitzgerald.

Q Okay.

A And Tim Jones. There were one or two other  
people present but I don't remember their names.

Q Who does Tim Jones represent, if you know? 09:10AM

A He works for Tyson.

Q Okay. What kind of questions did they ask you  
in that meeting?

A It was very general. What's my experience  
with nitrogen, phosphorus, other nutrients used in 09:10AM  
agricultural production systems, what's my  
experience with how those nutrients move through the  
landscape and what's the impact on water bodies of  
nutrients that may or may not flow from the  
landscape into the water body. I felt they were 09:10AM  
just trying to assess what my areas of expertise  
were. There were some areas, of course, during the  
course of the discussion where I didn't really have  
much to offer to the questions they were asking.

Q Did you get any sort of assignment or 09:10AM

9

1	<b>engagement at the end of that meeting?</b>		know. We've done these classes many times, and	
2	A No, I didn't. As a matter of fact, it was		there's various audiences, and I don't have a roster	
3	probably a year later before I heard anything else		of attendees.	
4	from them.		<b>Q Was there anything in your preparation for the</b>	
5	<b>Q When did you next hear anything from them?</b>	09:11AM	<b>preliminary injunction hearing, as you looked at</b>	09:13AM
6	A It was a year later, probably December of '07.		<b>studies or whatever, that you didn't already know in</b>	
7	<b>Q What happened in December of '07 pertinent to</b>		<b>a general sense; did you learn anything?</b>	
8	<b>this case?</b>		A Basically I had a general understanding of	
9	A Again, I believe it was Mr. Webster contacted		what we covered before the preliminary injunction	
10	me and told me about the preliminary injunction	09:11AM	hearing.	09:14AM
11	hearing that was coming up, and he kind of explained		<b>Q Have you been involved in the adoption of the</b>	
12	to me where they were going with that, and I didn't		<b>Maryland phosphorus index?</b>	
13	know anything about it at the time, and offered --		A Yes, I have.	
14	asked me if I would be interested in offering my		<b>Q What was your involvement in that, sir?</b>	
15	expertise in trying to understand some of the	09:11AM	A Well, I was one of the individuals who	09:14AM
16	phosphorus index issues and soil phosphorus issues		developed -- we call it the Maryland phosphorus site	
17	that would be involved in that hearing.		index. Just a little different terminology; means	
18	<b>Q What did you say?</b>		the same thing. I was involved in the development	
19	A I said, sure, yes.		of that and publication of -- writing the	
20	<b>Q What did you do to prepare to testify in the</b>	09:11AM	publications to describe how to manage it and use it	09:14AM
21	<b>preliminary injunction hearing?</b>		in the field, and as we talked about earlier, I've	
22	A There were -- I'm trying to remember what came		been involved with holding training sessions for	
23	at what point in time. Most of it was I reviewed		individuals who want to become trained in how to use	
24	work on phosphorus index principles, development and		it.	
25	application to understand how that would apply to	09:12AM	<b>Q Since your testimony in the preliminary</b>	09:14AM
	10		12	
1	the purpose of that hearing.		<b>injunction hearing, what have you done to get ready</b>	
2	<b>Q Do you teach classes at the University of</b>		<b>to testify at trial?</b>	
3	<b>Maryland on phosphorus indices?</b>		A Prepared this declaration, this report that	
4	A Teach extension education classes, not		was submitted, and in there it indicates several	
5	undergraduate classroom on-campus type classes.	09:12AM	documents I reviewed, considered and included in	09:15AM
6	<b>Q What do you mean when you say extension</b>		some cases to back up my opinions up in here.	
7	<b>education classes?</b>		<b>Q Let me hand you a document you will be</b>	
8	A Well, part of our role at the university,		<b>familiar with, and I will mark this as Plaintiff's</b>	
9	being a land grant university, is to offer education		<b>Exhibit 1. Pardon me. Hang on just a minute.</b>	
10	to the public, and for this mission, our public are	09:12AM	MR. McDANIEL: Is it okay with you if we	09:16AM
11	individuals in the community who are dealing with		mark the bottom of the stickers Coale?	
12	agricultural and nutrient issues, whether it be		MR. NANCE: Not at all.	
13	farmers or consultants or advisors or state agency		MR. McDANIEL: And either you can do it or	
14	personnel, federal agency personnel. So we've		Lisa can do it. Thank you.	
15	taught many training classes for that population of	09:13AM	MR. NANCE: I'll try to remember to do it,	09:16AM
16	student on phosphorus index.		and if I forget it, I'll count on Lisa to do it.	
17	<b>Q Have representatives of any of the poultry</b>		<b>Q Is that a copy of your declaration in this</b>	
18	<b>integrators attended any of those classes?</b>		<b>case?</b>	
19	MR. McDANIEL: Bob, you mean the defendants		A Yes, looks like it is.	
20	in this case?	09:13AM	<b>Q Okay. I notice you brought in a copy with</b>	09:16AM
21	MR. NANCE: The defendants in this case.		<b>you. Did you bring in a copy of the same thing?</b>	
22	A Not that I know of.		A Yes. It looks like it's identical to the one	
23	<b>Q Have representatives of any poultry industry</b>		I brought with me.	
24	<b>trade groups attended those classes?</b>		<b>Q Okay. Dr. Coale, other than looking at the</b>	
25	A I can't answer that for certain. I don't	09:13AM	<b>declaration, did you do anything to get ready to</b>	09:16AM
	11		13	

1	testify today?		necessarily true.	
2	A Yesterday I sat down with Mr. McDaniel and his		<b>Q You say in Paragraph B, which is the next</b>	
3	colleague, and this being my first deposition, they		<b>paragraph down, the second sentence, in most</b>	
4	kind of walked me through how it would work and what		<b>agricultural field production situations, sufficient</b>	
5	to expect, and then we walked through my declaration	09:17AM	<b>quantities of micronutrients are available as a</b>	09:19AM
6	and made sure I was comfortable with everything that		<b>result of organic matter, decomposition and mineral</b>	
7	was in there and we walked through some other, the		<b>weathering in the soil. Apart from the contribution</b>	
8	transcript from the PI testimony and made sure I was		<b>of litter, would that be true generally of the soils</b>	
9	comfortable with that.		<b>in the Illinois River watershed?</b>	
10	<b>Q Okay, and are you comfortable with Plaintiff's</b>	09:17AM	A I don't think I'm qualified to speak	09:20AM
11	<b>Exhibit 1, which is your declaration?</b>		specifically about micronutrients in the Illinois	
12	A Yes, I am.		River watershed soils. I just haven't studied them.	
13	<b>Q Let's, if we could, Dr. Coale, turn to Page 3</b>		<b>Q And if I say IRW, can we understand that I</b>	
14	<b>of that declaration and look at the very top of the</b>		<b>mean Illinois River watershed?</b>	
15	<b>page. I believe that is Paragraph 3A of the</b>	09:17AM	A Yes, sir.	09:20AM
16	<b>declaration.</b>		<b>Q Okay. Let's turn to the page and look at</b>	
17	A Uh-huh.		<b>Subparagraph H, Dr. Coale. You say in the first</b>	
18	<b>Q You have a sentence, and I'm just going to</b>		<b>line of that subparagraph that poultry litter is a</b>	
19	<b>read it and then just ask you what it means, okay,</b>		<b>heterogeneous mixture of various things. What do</b>	
20	<b>if I could. It's the very top sentence. Contrary</b>	09:17AM	<b>you mean when you say heterogeneous mixture?</b>	09:20AM
21	<b>to a statement presented in Section 4A of Dr. Gordon</b>		MR. McDANIEL: You did paraphrase his words	
22	<b>Johnson's expert report, and then it cites to the</b>		when you said various things?	
23	<b>report, it is incorrect to categorically equate the</b>		MR. NANCE: I did, yeah.	
24	<b>relative quantity of each essential plant nutrient</b>		MR. McDANIEL: Go ahead.	
25	<b>required by plants and the frequency of deficiency</b>	09:18AM	A Heterogeneous mixture means it's not uniformly	09:21AM
	14		16	
1	<b>of any specific nutrient in soils. Did I read that</b>		mixed. It's not homogenous. It's -- it's a mixture	
2	<b>correctly?</b>		that's not uniform across top to bottom, east to	
3	A Yes, you did.		west, north to south.	
4	<b>Q Okay. What did you mean in that sentence?</b>		<b>Q Later on about six lines down you give an</b>	
5	A Simply I mean it's incorrect to assume that	09:18AM	<b>example or you are talking about litter. It says --</b>	09:21AM
6	simply because a crop needs a larger quantity of a		<b>I'll read the sentence and then we'll talk about it.</b>	
7	particular nutrient, that the potential to have a		<b>For example, N is not separated from the P and the P</b>	
8	deficiency for that nutrient is higher than the		<b>is not separated from the K. Did I read that</b>	
9	potential for having a deficiency of a nutrient		<b>correctly?</b>	
10	where the crop needs a smaller or less quantity of	09:18AM	A Yes, you did.	09:21AM
11	that nutrient for its growth.		<b>Q And if we talk about N, are we talking about</b>	
12	<b>Q Let me give you a for instance and see if I'm</b>		<b>nitrogen?</b>	
13	<b>getting what you're saying. Plants need more</b>		A Yes.	
14	<b>nitrogen than they do zinc; is that correct?</b>		<b>Q And P is phosphorus?</b>	
15	A That's correct.	09:19AM	A Yes.	09:21AM
16	<b>Q But is your point here that it would be</b>		<b>Q And K is potassium?</b>	
17	<b>incorrect to say that it's more likely you're short</b>		A Yes, it is.	
18	<b>of nitrogen than zinc just because it needs more?</b>		<b>Q Okay. So do I understand correctly that in</b>	
19	A Well, from a soil fertility, that's a very		<b>poultry litter, you can't separate the nitrogen from</b>	
20	difficult example you gave because zinc and nitrogen	09:19AM	<b>the phosphorus and the phosphorus from the</b>	09:21AM
21	are very, very, very different in how they behave,		<b>potassium, for instance?</b>	
22	but in generality if you have a nutrient that you		A As it's managed on the farm?	
23	need a large quantity of, in your example nitrogen,		<b>Q Correct.</b>	
24	saying there's a higher probability of having a		A That's absolutely correct. You have to manage	
25	nitrogen deficiency than a zinc deficiency isn't	09:19AM	it as a whole, as an entity of itself.	09:22AM
	15		17	

1 **Q Is there any way off the farm to separate**  
2 **these particular constituents?**  
3 A Oh, I'm sure it can be done, but I don't know  
4 how to do it.  
5 **Q Okay. It's not your area and you're not going 09:22AM**  
6 **to offer any testimony on that?**  
7 A No, I'm not.  
8 **Q Okay. Then you say -- the next sentence is,**  
9 **farm management decisions regarding utilization of**  
10 **poultry litter nutrients must be based on the most 09:22AM**  
11 **efficient and effective use of the single product**  
12 **poultry litter. Did I read that right?**  
13 A Yes, you did.  
14 **Q Okay. What did you mean by that sentence,**  
15 **sir? 09:22AM**  
16 A When you're making farm management decisions  
17 about how to utilize the poultry litter that you  
18 have available on the farm, you can't break it up  
19 into its component constituents of potassium or  
20 phosphorus or nitrogen and put the potassium one 09:23AM  
21 place and the phosphorus another place and nitrogen  
22 another place. That goes along with being a  
23 heterogeneous mixture in a single entity. So you  
24 make a decision about how you are going to utilize  
25 it based on having to utilize the whole intact 09:23AM

18

1 product and not break it up into its constituents.  
2 **Q What do you mean when you say it must be the**  
3 **most efficient use?**  
4 A Well, it's a valuable product, so you want to  
5 use it the most efficiently you can on the farm to 09:23AM  
6 help enhance crop growth, and you don't want to use  
7 it in a manner where you are not getting the most  
8 benefit from it on the farm, and that's what I mean  
9 by efficient.  
10 **Q What do you mean when you say you must get the 09:23AM**  
11 **most effective use?**  
12 A I'd say they would be synonymous with  
13 efficient.  
14 **Q Again, in very general terms, Dr. Coale, would**  
15 **it be true that the ratio of nitrogen to phosphorus 09:24AM**  
16 **in litter is approximately one to one?**  
17 A In very general terms, that may be the  
18 ballpark it is in, but, of course, if you are trying  
19 to do the most efficient and effective management,  
20 you have the litter analyzed so you know exactly 09:24AM  
21 what you are dealing with so you know the -- what  
22 the pounds per ton of nitrogen, phosphorus,  
23 potassium are available from that litter, but to  
24 make an overall assumption, boil down all that data  
25 together, it's roughly in that ballpark because 09:24AM

19

there's a variable range.

**Q Okay, and do I remember correctly that the**  
**plant need for nitrogen is greater than the need for**  
**phosphorus, and let's just talk forage crops like**  
**we're going to be dealing with in the IRW. 09:24AM**

A Forage grasses, not legumes. Forage grasses,  
yes, the primary demand would be for nitrogen. They  
need a larger quantity of nitrogen in the forage  
grass.

**Q And if you meet the nitrogen need for forage 09:25AM**  
**grasses with litter, you're going to over apply for**  
**phosphorus as a general rule?**

A As a general rule, if you are applying litter  
to a pasture to supply the pasture with the nitrogen  
it needs for maximum productivity, whether or not 09:25AM  
you're applying the right amount of phosphorus on it  
depends on the soil test level phosphorus -- excuse  
me, soil test level -- phosphorus soils test level  
of the soil is what I'm trying to say. So in some  
cases, yes; in some cases, no. 09:25AM

**Q Historically part of the problem we're dealing**  
**with here is that people have used litter to meet**  
**their nitrogen need and over applied phosphorus?**

MR. McDANIEL: Object to the form.

A Do I continue? 09:25AM

20

**Q You can go ahead and answer the question.**

MR. McDANIEL: If you understand the  
question, go ahead.

A Could you repeat the question, please? I got  
a little confused there. 09:26AM

**Q Historically part of the problem we're dealing**  
**with in this lawsuit is that people have used litter**  
**to meet the nitrogen need of the forage and have**  
**over -- and consequently over applied phosphorus?**

MR. McDANIEL: Same objection. 09:26AM

A Okay. I don't have firsthand knowledge of  
what farmers in the IRW did. I know, based on my  
firsthand experience of poultry litter utilization  
in other parts of the country, that in past years  
recommendations were to apply litter to supply the 09:26AM  
nitrogen needs of the crop without much regard given  
to what the phosphorus supplying the litter was.

**Q The proposition I put forward in that question**  
**is not an alien one to you in your profession, is**  
**it? 09:26AM**

MR. McDANIEL: Object to the form.

A I believe it has happened in the past.

**Q Okay. Are you suggesting it hasn't happened**  
**in the Illinois River watershed?**

A No, sir, I'm not suggesting that. 09:27AM

21



1 **Q** Okay, but you haven't personally gone out and  
2 seen what farmers have done in the Illinois River  
3 watershed?  
4 A That's correct.  
5 **Q** Okay, but it's something -- the use of litter 09:27AM  
6 for nitrogen needs and the over application of  
7 phosphorus is something you're familiar with in your  
8 professional work?  
9 MR. McDANIEL: Object to the form.  
10 A In my professional work, in the past 09:27AM  
11 recommendations, I mean past decades ago, we were  
12 recommending applying litter based on the nitrogen  
13 needs of the crop, and I am aware of times when that  
14 resulted in application of phosphorus more than the  
15 crop would need by recommendation. 09:27AM  
16 **Q** In your professional field, is that a common  
17 understanding or is that something you're telling me  
18 is just something that's happened in a few instances  
19 you know of?  
20 A I think it happens fairly commonly. 09:28AM  
21 **Q** Okay. Now, back to Subparagraph H there on  
22 Page 4 --  
23 A H did you say?  
24 **Q** H, yes.  
25 A Okay. 09:28AM

22

1 **Q** Why did you talk about farm management  
2 decisions?  
3 A Because as a reference to farm management  
4 decisions, based on utilizing the litter in a farm  
5 operation, litter is being produced on the farm. 09:28AM  
6 You utilize it on the farm to -- in its most  
7 efficient manner. So that's part of the whole farm  
8 management is how to utilize it efficiently.  
9 **Q** If you were managing the whole watershed,  
10 would you still want to get the most efficient and 09:28AM  
11 effective use of litter?  
12 MR. McDANIEL: Object to the form.  
13 A My understanding is that the litter would  
14 still be managed at the farm level, so my comments  
15 were based on managing litter at the farm level. 09:29AM  
16 **Q** Would the most efficient and effective use of  
17 litter be, at least as regards nitrogen and  
18 phosphorus, on the location that is otherwise  
19 appropriate for litter in terms of slope and the  
20 soil and all of that, where there is a need for both 09:29AM  
21 nitrogen and phosphorus?  
22 A The most efficient use of litter would be  
23 where there would be a need for both nitrogen and  
24 phosphorus by the crop you are trying to grow.  
25 **Q** And let's talk about something here just so we 09:29AM

23

can kind of come to an understanding. There are  
some fields, for instance, which are simply  
inappropriate for the use of litter by virtue of  
their slope or the shallowness of their soil or the  
rockiness or the prone -- proneness to flooding and 09:30AM  
things like that; is that a fair statement?  
A Yes. From both a practical and from a  
management point of view, yeah, you wouldn't want to  
do that.  
**Q** Okay. Unless we say differently, can we 09:30AM  
assume that in our discussion today, we are talking  
about fields where it's appropriate to apply litter?  
I'll ask you about pastures and applying litter, and  
let's just assume, can we, that we're talking about  
appropriate locations? 09:30AM  
MR. McDANIEL: Let me -- I object to the  
form of that question in asking that that be assumed  
throughout the deposition. Go ahead.  
A I would prefer that we specify as we go  
through here because I want to be cautious I don't 09:31AM  
misspeak. So there are some -- I'd rather say where  
other restrictions don't limit litter application.  
I'd rather we specify as we go.  
**Q** Okay. It's going to make for longer  
questions. 09:31AM

24

A Well, I want to make sure I understand where  
we are going.  
**Q** All right.  
MR. ELROD: You sure you've never given a  
deposition before? 09:31AM  
A No, sir.  
MR. NANCE: Pretty good first time out of  
the box, isn't he?  
MR. ELROD: Yeah.  
**Q** All right. Dr. Coale, what if the most 09:31AM  
efficient and effective location to use litter where  
there are other restrictions that don't apply is not  
on the farm where it's generated?  
A The problem is you may be able to utilize it  
on a situation on a field where it's not the most 09:32AM  
efficient and effective, but it is an -- the next  
step down in efficiency and effectiveness, and so  
you're making a decision that it's still effective,  
maybe not the ideal scenario, but it's still  
effective, and it might be a reasonable place to 09:32AM  
apply it.  
**Q** But you say it must be managed?  
A Well --  
**Q** Must be based on the most efficient and  
effective use. 09:32AM

25

1 A That is available. So the most efficient and  
2 effective scenario that's available to that farmer.  
3 That farmer might not have the panacea of the best  
4 position to apply it, but within his options, we  
5 recommend he assess his options and within his 09:33AM  
6 options, apply it in the best, most efficient and  
7 effective manner that he has available. Every farm  
8 is different.

9 **Q Are you wedded in your professional work to**  
10 **the notion that the decision is going to be made by** 09:33AM  
11 **a farmer?**

12 A My role and job is to advise farmers to make  
13 the best decisions they can make.

14 **Q Do you ever advise people who manage**  
15 **watersheds at a higher level than a farm?** 09:33AM

16 A Yes.

17 **Q Who are those people you advise?**

18 A It can vary. State regulatory agencies,  
19 watershed groups.

20 **Q Give me an example of a watershed group you've** 09:33AM  
21 **advised.**

22 A The -- I forget the -- a tributary strategy  
23 team. In Maryland there's called tributary teams.  
24 There's groups of individuals, business  
25 professionals, farmers, scientists, advisors who 09:34AM

26

**Q Is litter ever moved from one entire watershed**  
**to another entire watershed to improve water**  
**quality?**

A Yes.

**Q And would you endorse that if you got the most** 09:35AM  
**efficient and effective use of the litter?**

MR. McDANIEL: Object to the form.

A The first step in making that evaluation is  
can it be used effectively locally on the property  
where it was generated, and then if you can, you 09:35AM  
come up with a management plan to try to make it be  
used effectively there. If that proves to be  
impossible, then you look at the next step, which is  
moving it somewhere else.

**Q And if you -- well, at what point -- I'm** 09:36AM  
**puzzled because you say pretty categorically farm**  
**management decisions regarding utilization of**  
**poultry litter must be based on the most efficient**  
**and effective use of the single product, poultry**  
**litter. Are you telling me that farmers are making** 09:36AM  
**decisions that aren't the most efficient and**  
**effective use of that litter?**

A No. I'm saying, like I mentioned before, most  
efficient and effective use based on the options  
they have available to them. Okay? On their own or 09:36AM

28

1 work on certain segments of the watershed and come  
2 up with plans how we should best manage this water,  
3 their section of that watershed, and we advise those  
4 people.

5 **Q Do those people ever move litter off a farm to** 09:34AM  
6 **a place where it is used in the most efficient and**  
7 **effective manner?**

8 A Those people in those tributary strategy  
9 groups don't move litter. They come up with plans.  
10 They don't move litter. I've worked with farmers 09:34AM  
11 who do move litter from one field to another field  
12 or from one part of the watershed to another part of  
13 a watershed because they can't find an efficient way  
14 to use it on their property.

15 **Q Okay. Do you work with farmers who ever move** 09:34AM  
16 **litter out of a watershed to another location where**  
17 **it may be most efficiently and effectively used?**

18 A Yes.

19 **Q Is that an appropriate thing agronomically?**

20 A There's times when it is. 09:35AM

21 **Q Is that an appropriate thing environmentally?**

22 MR. McDANIEL: Object to the form.

23 A Moving litter from one subwatershed to another  
24 subwatershed is often done to help protect water  
25 quality. 09:35AM

27

leased or managed property, they may not have --  
they may have an option to utilize litter that's  
just fine, it may be a very good utilization, but  
they may be in a situation where they don't, and if  
that's the case, then they would be looking for an 09:37AM  
alternative utilization site, and that may be on  
their farm, on an adjacent farm or there's an active  
manure transport program that's subsidized --  
talking about the state of Maryland now -- where  
some states subsidizes transport. So if they decide 09:37AM  
it's worth their while to have a third party ship it  
to another farm who can utilize it efficiently, they  
may be worth -- from their business point of view,  
that may be their best option.

**Q So in the real world where you practice --** 09:37AM

A Uh-huh.

**Q -- farm management often doesn't get the most**  
**efficient and effective use of litter in the sense**  
**that the litter is put where there is a need for**  
**both nitrogen and phosphorus?** 09:37AM

A Oftentimes litter is applied where there's not  
both a need for nitrogen and phosphorus on that  
field.

**Q Okay. As a matter of your professional**  
**opinion, would you believe that that would be true** 09:38AM

29



1 in the Illinois River watershed as well as in  
 2 Maryland?  
 3 A I believe in some fields it would be and in  
 4 some fields it wouldn't be. I think it would be  
 5 very site specific. 09:38AM

6 **Q You've looked at the data on some of the STPs**  
 7 **in the Illinois River watershed, haven't you?**

8 A I have looked at some of that data.

9 **Q And do you dispute Dr. Johnson's opinion that**  
 10 **those elevated STPs are caused by over application** 09:38AM  
 11 **of phosphorus from litter?**

12 A Again, I don't have any firsthand knowledge of  
 13 that, but based on what I've been told about how --  
 14 what the production sequence and what agricultural  
 15 production in the IRW is like, then one, you know, 09:38AM  
 16 possible scenario would be that there would be  
 17 elevated phosphorus on some sites in the soil due to  
 18 past litter applications.

19 **Q What are the other plausible ways that STP**  
 20 **would get so high in this watershed?** 09:39AM

21 MR. McDANIEL: Object to the form.

22 A Well, again, it's going to be a site-by-site  
 23 determination. It could have been fields where  
 24 commercial fertilizer has been over applied and a  
 25 higher rate of P application, and then for a lesser 09:39AM

30

journals and studies come across any reports where  
 STP levels in the IRW have been raised very high by  
 commercial fertilizer?

A I'm not aware of that.

**Q Are there any other mechanisms that might be** 09:40AM  
**at work in the IRW to create the high kind of STPs**  
**we see in some sites there?**

A From what I've learned about management of  
 soils in the IRW, no, I can't think of any that  
 would be commonplace. 09:41AM

**Q Okay. Is there any circumstance, Dr. Coale,**  
**where you would be able to use litter, for instance,**  
**in a different watershed where it could be**  
**efficiently and effectively used, in the sense of**  
**meaning both nitrogen and phosphorus, that would** 09:41AM  
**maximize the economics of an out-of-watershed farm?**

A That would be a matter of -- if I'm maximizing  
 economics, that would be a matter of what the cost  
 of different sources of nutrients were for that farm  
 that was out of the watershed. If it was more 09:42AM  
 financially efficient, cheaper for the farm that's  
 outside the watershed to transport litter from a  
 different farm inside the watershed to satisfy the  
 crop they're growing outside the watershed, nitrogen  
 and phosphorus needs and use litter to do it, then 09:42AM

32

1 P application was needed and elevated the soil test  
 2 P level.

3 **Q Do farmers in Maryland typically pay for**  
 4 **commercial fertilizer and drive the STP up that**  
 5 **high?** 09:39AM

6 A I would not like to think it was typical, but  
 7 I know it has happened.

8 **Q Okay. It would -- would it be fair to say**  
 9 **that that would be an exception rather than a rule**  
 10 **as a mechanism for getting an extremely high STP?** 09:39AM

11 MR. McDANIEL: Object to the form.

12 A It really depends on -- now you brought up in  
 13 reference that question was in Maryland. It's very  
 14 different agricultural production systems. There  
 15 are some where it was standard practice to raise 09:40AM  
 16 soil phosphorus levels extremely high with  
 17 fertilizer additions over the years. That  
 18 doesn't -- in my knowledge doesn't apply -- can't be  
 19 applied to situations in the IRW. Hopefully those  
 20 practices have stopped now. 09:40AM

21 **Q Are you personally aware of any instances in**  
 22 **the IRW where commercial fertilizer has been**  
 23 **employed to drive the STP up very high?**

24 A Personally, no.

25 **Q Have you in your professional research and** 09:40AM

31

it would be a good business decision for the farm  
 outside the watershed. On the contrary, flip side  
 of that would be that if the farm outside the  
 watershed could purchase nitrogen fertilizer,  
 commercial fertilizer or phosphorus from commercial 09:42AM  
 fertilizer from a fertilizer dealer to supply the  
 needs of his crop at a lower rate, a lower cost,  
 then it wouldn't be efficient.

**Q Okay. Agronomically are we getting the best**  
**use of poultry litter if it's used on a pasture** 09:43AM  
**where other restrictions don't apply and where there**  
**is a need for both nitrogen and phosphorus?**

MR. McDANIEL: Object to the form.

A Again, I'll go back to the decision the farmer  
 is making on his farm. 09:43AM

**Q I'm just talking agronomics at this point.**  
**It's just an agronomic question.**

A General agronomics, if you can satisfy two  
 nutrients need of the crop, whether nitrogen or  
 phosphorus nutrient need, with the application of a 09:43AM  
 single material, poultry litter in this case, yes.

**Q Environmentally is it better to apply poultry**  
**litter on a pasture where other restrictions don't**  
**apply where there is a need for both nitrogen and**  
**phosphorus?** 09:44AM

33

1 MR. McDANIEL: Object to the form.  
2 A The potential environmental ramifications of  
3 applying litter on a pasture field is going to be  
4 extremely site specific, extremely dependent on the  
5 conditions of that field and that application, that 09:44AM  
6 I don't think you can make a blanket statement  
7 saying yes or no. It's going to be depending on the  
8 site.  
9 Q I'm talking about a site now where other  
10 restrictions don't apply. 09:44AM  
11 A I understand that.  
12 Q Okay. Is it environmentally better to put  
13 litter where the STP is lower or environmentally  
14 better, all things being equal, where STP is higher?  
15 MR. McDANIEL: Object to the form. 09:45AM  
16 A Again, it's site specific. Some cases, some  
17 sites it wouldn't make any difference. In other  
18 sites it might make a difference. That risk to the  
19 environment has to be assessed on the site-specific  
20 basis. 09:45AM  
21 Q So you're not willing to say, all things being  
22 equal in sites where no other restrictions apply,  
23 that it's environmentally better, two identical  
24 fields, to place the litter on a site with low STP  
25 than high STP? 09:45AM

34

1 MR. McDANIEL: Objection. It's asked and  
2 answered.  
3 A Again, I think you have to assess each site,  
4 and I think you can't make a blanket statement like  
5 that. 09:46AM  
6 Q Assume for purposes of my question you have  
7 assessed the site using any phosphorus index you  
8 want to use --  
9 A Uh-huh.  
10 Q -- and they are identical, and they are sites 09:46AM  
11 where no other restrictions apply, the only  
12 difference between the two sites is one has an STP  
13 of 30 and the other has an STP of 300.  
14 A Okay.  
15 Q Which is the better environmental application? 09:46AM  
16 MR. McDANIEL: Object to the form.  
17 A The goal of a phosphorus index assessment, a  
18 general overall goal is to be instructive. So when  
19 you do the assessment, it advises the assessor of a  
20 relative risk for phosphorus loss. So if everything 09:46AM  
21 else is equal and the relative risk outcome as  
22 predicted by the phosphorus index tool is equal,  
23 then the risk is equal.  
24 Q Well, I didn't say the assessments were equal.  
25 I said the fields were the same, the only difference 09:47AM

35

being the STP levels.  
A Well, then you also mentioned about using the  
phosphorus index to assess the site.  
Q I mean if -- and I did that, Doctor, because  
you're hung up on site-specific assessments. 09:47AM  
A Yes, I am.  
Q I'm telling you for the purpose of this  
question -- this is a hypothetical question. For  
the purposes of this question, these fields are  
identical in every respect except the STP level; one 09:47AM  
is 30, the other is 300.  
A Uh-huh.  
Q Which is the better environmental place to  
apply the litter?  
MR. McDANIEL: Object to the form. 09:47AM  
A And we assess environmental risk using a tool  
like a phosphorus index tool; correct?  
Q If you want to, however you want to do it.  
A I would use the output from that assessment  
tool to tell me which was the most environmentally 09:48AM  
sensitive site.  
Q As between those two identical fields,  
different only in their STPs, what would any  
phosphorus index you want to use say would be the  
better place to put the litter? 09:48AM

36

MR. McDANIEL: Object to the form.  
A I can't answer that because I have seen the  
phosphorus index used on soils that had elevated STP  
levels, which the outcome of the phosphorus index  
assessment said there was negligible environmental 09:48AM  
impact, and I have seen the phosphorus site index,  
phosphorus index used on soils that had a much lower  
soil STP level where the outcome of the phosphorus  
site index was -- the potential risk was higher. So  
it really is a very difficult scenario that I don't 09:48AM  
think I can give you a straight answer to other than  
to follow the recommendation of the output of a  
phosphorus index assessment on that site.  
Q You realize we're doing a mental experiment  
here? I mean, do you understand that's what we're 09:49AM  
doing?  
MR. ELROD: Doing what?  
A I don't understand what that means.  
MR. McDANIEL: What I understand we are  
doing is asking very grossly broad hypotheticals, 09:49AM  
but you can characterize it as you wish. Go ahead.  
Q You and I are doing a mental experiment here,  
okay, and I'm not asking about any field that you've  
ever looked at in the real world.  
A Uh-huh.

37

1 **Q** I'm asking about two fields that are  
2 **completely identical --**  
3 A Okay.  
4 **Q -- in every respect except the STPs of the**  
5 **soil. 09:49AM**  
6 A Right.  
7 **Q Let's break it down in smaller bytes. The**  
8 **Maryland phosphorus site index --**  
9 A Uh-huh.  
10 **Q -- two identical fields -- 09:49AM**  
11 A Uh-huh.  
12 **Q -- different only in their STPs?**  
13 A Correct.  
14 **Q How would the Maryland site index rate the**  
15 **risk of phosphorus loss between the low field and 09:50AM**  
16 **the high field?**  
17 A Numerically the output from the phosphorus  
18 site index would rate the field that had a higher  
19 soil test level at a higher numerical risk than the  
20 lower STP field, but that doesn't mean once you have 09:50AM  
21 a higher -- once the numerical number is calculated,  
22 you evaluate that by how it falls into broad  
23 categories of risk. That numerical output may be  
24 numerically higher, but it doesn't necessarily mean  
25 it's bounced into the next higher category of risk. 09:50AM

38

1 **Q So there are categories in your phosphorus**  
2 **site index as well as a numerical rating?**  
3 A Correct.  
4 **Q Let's make it a little easier. Same two**  
5 **identical fields, no other restriction applied. The 09:50AM**  
6 **STP on one is 30 and the STP on the other is 3,000.**  
7 A Okay.  
8 **Q Would there be any different output in terms**  
9 **of the broad categories your Maryland site index**  
10 **uses? 09:51AM**  
11 A The bottom line is I don't know. Let me give  
12 you an example. Can I do that?  
13 **Q Please.**  
14 A Okay. If these two identical sites had a  
15 severely high erosion potential, okay, then the risk 09:51AM  
16 may be extremely high for phosphorus losses on both  
17 of them simply due to the erosion factor, which  
18 has -- which would totally overwhelm the importance  
19 of the soil test P level. So you got to be really  
20 careful when you're -- that's why these assessment 09:52AM  
21 techniques are built with many different factors in  
22 them because there can be a single factor that  
23 override all the others, in this case maybe erosion.  
24 There may be other factors which override the other  
25 ones. STP level is not always the dominant 09:52AM

39

contributing factor to the overall assessment.

**Q So you're telling me two fields with identical**  
**erosion factors would result in the same rating even**  
**if the STP level was 100 times?**

A They may. 09:52AM

**Q How often does that happen in the real world?**

A You offered a hypothetical, and I was trying  
to see if I could think of on the spot where the  
hypothetical would not be true, and that's -- I  
offered that case where this may be a case that's 09:52AM  
not true. So I don't want to categorically say that  
it's always true.

**Q Okay, but for the counter hypothetical you've**  
**given me, would my hypothetical be true, that you**  
**would get a higher risk from a higher STP in these 09:53AM**  
**two identical fields where there are no other**  
**limiting factors?**

MR. McDANIEL: Object to the form. It's  
been asked and answered multiple times.

A Not categorically all the time because I can 09:53AM  
think of situations where it wouldn't happen.

**Q Other than the erosion situation, where would**  
**it not happen?**

MR. McDANIEL: Same objection.

A That's the most logical scenario I can think 09:53AM

40

of right now. I can't think of another one.

**Q Okay. Dr. Coale, if cost were not a factor,**  
**would it be agronomically best to use litter on that**  
**field where both nitrogen and phosphorus are needed**  
**and there are no other limiting factors? 09:54AM**

MR. McDANIEL: Cost to whom?

MR. NANCE: To the farmer.

MR. McDANIEL: Object to the form.

A I'm trying to think of a scenario where cost  
is not a factor. That's always a factor. 09:55AM

**Q Okay. Here's the scenario: Federal court**  
**says the defendants pay to transfer it. The farmer**  
**is out no money.**

A Okay.

MR. McDANIEL: Wait a minute. Finish your 09:55AM  
question, Bob, so there's a clear Record of what the  
question is.

**Q Here's the question: In a circumstance in**  
**which the defendants are ordered by the court to pay**  
**for the transfer of the litter -- 09:55AM**

A Uh-huh.

**Q -- so the farmer doesn't bear the cost of**  
**transport -- we'll break it down -- is it**  
**agronomically better to use the litter on a field**  
**where both nitrogen and phosphorus are needed and 09:55AM**

41

1 **there are no other factors that limit the use of**  
2 **litter there?**  
3 MR. McDANIEL: Object to the form.  
4 A Okay, and so I get the terminology right, I'm  
5 assuming when you say defendants, you mean the 09:55AM  
6 defendants in this case; is that --  
7 **Q That's my question, yes.**  
8 A Okay. If there's no financial burden on the  
9 farmer --  
10 **Q Right. 09:56AM**  
11 A -- and he's assessed his property and he  
12 doesn't have a very efficient utilization scheme on  
13 his property and it doesn't cost him anything to  
14 have that litter transported somewhere else and he  
15 doesn't need it agronomically on his property, then, 09:56AM  
16 yes, that could work out agronomically.  
17 **Q Okay. Same question -- we'll look at it from**  
18 **a little different angle. Suppose the court orders**  
19 **the defendants to pay for the transport and there is**  
20 **a field that is -- has otherwise no restrictions on 09:56AM**  
21 **use of litter and it has a need for both nitrogen**  
22 **and phosphorus --**  
23 A Uh-huh.  
24 **Q -- and the farm where it's being produced has**  
25 **high phosphorus. 09:57AM**

42

somewhere else and apply it, and that was a scenario  
where the assessment was made that there wasn't a  
high risk for phosphorus loss.  
**Q And under those circumstances, you're willing**  
**to give up your categorical statement that farm 09:59AM**  
**management decisions regarding utilization of**  
**poultry litter nutrients must be based on the most**  
**efficient and effective use of the single product?**  
MR. McDANIEL: Object to the form. It's  
argumentative. 09:59AM  
A What I'm saying is for that scenario, that is  
his most efficient and effective use that he has  
available.  
**Q But it's not the most efficient and effective**  
**use of the litter because he doesn't need phosphorus 09:59AM**  
**on his soil?**  
A In that scenario he doesn't need phosphorus on  
his soil, correct.  
MR. NANCE: We've got a five-minute  
warning. Let's take a quick break and let him 09:59AM  
change tapes.  
VIDEOGRAPHER: We're now off the Record and  
it's 10:01 a.m.  
(Following a short recess at 9:59  
a.m., proceedings continued on the Record at 10:15  
a.m.)

44

1 A Okay.  
2 **Q Is it environmentally better to move it to the**  
3 **field that needs both nitrogen and phosphorus?**  
4 MR. McDANIEL: Object to the form.  
5 A Well, the farmer is growing pasture grasses on 09:57AM  
6 his farm. Where the litter originates still is  
7 going to need nitrogen to supply nitrogen to his  
8 pasture crop. So he has a need for nitrogen, and if  
9 he can use that litter on that -- on those fields  
10 and supply the nitrogen he needs to the crop and can 09:57AM  
11 demonstrate that using a site phosphorus index  
12 assessment tool or something can demonstrate that  
13 there's negligible risk of phosphorus being lost to  
14 the environment, then he would be well served to use  
15 it on his property to supply the nitrogen needed for 09:58AM  
16 that forage.  
17 **Q So the status quo would remain; he would still**  
18 **be using it where it was being produced even though**  
19 **there's a need for it most efficiently and**  
20 **effectively somewhere else? 09:58AM**  
21 A The reason I offered that scenario was the  
22 farmer will still need nitrogen input for his  
23 pasture grasses; therefore, he would -- if he didn't  
24 use the litter there, he would be in a situation of  
25 having to purchase a nitrogen source fertilizer 09:58AM

43

a.m.)  
VIDEOGRAPHER: We are back on the Record.  
The time is 10:16 a.m.  
**Q Dr. Coale, before we broke to change the tape,**  
**you were telling me that the producer who got the 10:15AM**  
**litter from his house or whatever would have to**  
**replace the nitrogen he needed with commercial**  
**nitrogen if the litter went somewhere else; do you**  
**remember that?**  
A Yes, I do. 10:15AM  
**Q Okay. Let's think about that a little**  
**further. Our out-of-watershed field that's the**  
**potential destination in our thought experiment here**  
**needs nitrogen and phosphorus; right?**  
A That's the assumption, it needs both. 10:15AM  
**Q That's the way I set it up; right?**  
A Okay.  
**Q So the farmer that owns that field is having**  
**to put on commercial nitrogen if he wants the**  
**growth? 10:15AM**  
A Correct.  
**Q And he's having to put on commercial**  
**phosphorus; right?**  
A That would be the recommendation, yeah.  
**Q Okay. If the litter were moved from the 10:15AM**

45

1 **producer in the high phosphorus location to the**  
2 **field in the low phosphorus location --**  
3 A Uh-huh.  
4 **Q -- somebody would only have to buy nitrogen;**  
5 **right? 10:16AM**  
6 A In that scenario, yes. The producing farm  
7 would only have to buy nitrogen.  
8 **Q Okay. Instead of the receiving farm having to**  
9 **buy both nitrogen and phosphorus?**  
10 A Yes. 10:16AM  
11 **Q Which situation is environmentally better?**  
12 MR. McDANIEL: Object to the form.  
13 A Again, and this is the recommendation we used  
14 in situations I've been involved in where we have  
15 manure being transported from a producing to a 10:16AM  
16 receiving farm. Both farms at both ends, both the  
17 receiving farm and producing farm have to be under a  
18 nutrient management plan, where the receiving farm  
19 has to document that there is not going to be -- in  
20 most cases they used the phosphorus index to show 10:17AM  
21 that they're not going to be causing an  
22 environmental concern by putting the litter on the  
23 receiving farm. So, again, it depends on who is  
24 receiving it and what that landscape site and what  
25 those fields are like. 10:17AM

46

1 **Q Even though the receiving farm is putting on**  
2 **both nitrogen and phosphorus anyway?**  
3 MR. McDANIEL: Same objection.  
4 A The receiving farm should be managed within a  
5 nutrient management plan, yes. 10:17AM  
6 **Q In Oklahoma and Arkansas do you need a**  
7 **nutrient management plan if you're not using litter?**  
8 A I don't know what the regulations or rules are  
9 regarding that, but it's a good management practice.  
10 **Q To what extent have you personally been in the 10:17AM**  
11 **Illinois River watershed and looked it over?**  
12 A I don't know that I've ever been there.  
13 **Q To your knowledge, will the defendants have an**  
14 **expert testify who has been to the Illinois River**  
15 **watershed? 10:18AM**  
16 MR. McDANIEL: Object to the form.  
17 A I believe they will.  
18 **Q Who would that be?**  
19 A I don't know who is scheduled to testify.  
20 **Q Have you talked to any expert like that? 10:18AM**  
21 A Who is going to testify?  
22 **Q Who even might testify.**  
23 MR. McDANIEL: Well, he doesn't have to  
24 discuss talking to somebody who might testify. If  
25 they're designated -- if your question is, has he 10:18AM

47

communicated with other designated experts in this  
case, that's fine. I don't have any problem with  
him answering that.

MR. NANCE: Well, I'm asking about any  
expert who might testify. 10:18AM

MR. McDANIEL: Well, I object.

A I just don't know who is going to testify and  
who's not.

**Q What PhD level scholars, whether they are**  
**expert witness or not, have you talked about -- have 10:19AM**  
**you talked with about this watershed?**

A I've had telephone conversations with Billy  
Clay. I've had telephone conversations with Dr.  
Dicks. I can't remember his first name.

**Q D-I-C-K-S? 10:19AM**

A I believe that's how it's spelled, yes. Those  
are the only ones that I -- my recollection is that  
may have local knowledge.

**Q Have you talked with Dr. Sharpley?**

A Yes. 10:20AM

**Q He's now at the University of Arkansas?**

A Correct.

**Q Have you talked with him about the watershed?**

A Yes.

**Q What have you and Dr. Sharpley talked about 10:20AM**

48

**about the watershed?**

A Let me take that back. I misspoke. Not  
specifically about the IRW. We've talked  
professionally about the phosphorus indices and  
those kind of things. 10:20AM

**Q Did Dr. Sharpley indicate to you that he might**  
**testify?**

A No. As a matter of fact, he laughed when he  
learned that I was. He said good luck.

**Q What have you talked to Dr. Clay about? 10:20AM**

A He's been involved in a couple of conference  
calls where multiple individuals were involved, and  
my -- what I gleaned from those conversations from  
his input was getting a feel for what's common  
practice in the IRW and what farming operations are 10:21AM  
typically like across the watershed and practical  
assessment.

**Q And what about Dr. Dicks?**

A Dr. Dicks, our conversations were basically  
based on his conducting a statistical analysis and 10:21AM  
asking, from my perspective, as a soil scientist  
whether I thought what he was doing made sense, and  
that's basically what our conversation involved.

**Q In your profession, Dr. Coale, do you talk**  
**about the advisability or the benefit of having 10:22AM**

49

1 **poultry integrators be responsible for moving litter**  
2 **to efficient and effective locations?**

3 MR. McDANIEL: Object to the form, calls  
4 for a legal conclusion.

5 A No. Basically if the scenario arises where 10:22AM  
6 professionally it's suggested that litter be moved  
7 from one location to another, from my personal  
8 experience, that may be involved at a state  
9 regulatory level, and my -- again my personal  
10 experience in Maryland, I believe the poultry 10:23AM  
11 companies have been involved in helping to fund that  
12 operation but not totally.

13 **Q What have the poultry companies done in**  
14 **Maryland to help fund moving litter?**

15 A I'm not real clear on all the details of the 10:23AM  
16 program, the manure transport program. It's run  
17 through the Maryland Department of Agriculture. The  
18 Maryland Department of Agriculture subsidizes the  
19 transport costs, and my understanding is that the  
20 poultry companies bear a part of that cost. Whether 10:23AM  
21 it's a percentage or absolute number, I don't know.

22 **Q So am I hearing correctly that in Maryland the**  
23 **taxpayers fund moving some litter?**

24 A That's correct.

25 **Q And the integrators fund moving some litter?** 10:23AM  
50

where's the most effective and efficient use, what  
is the most efficient use of poultry litter in  
different situations, and if there is suggested by  
the profession generally to suggest that the litter  
needs to be moved from Point A to Point B, then I 10:25AM  
have never been involved in deciding who should pay  
for that.

**Q Has anyone in your profession that you know of**  
**recommended that the integrators be responsible for**  
**moving it?** 10:25AM

A Not that I recall.

**Q Why is that?**

A I just don't remember that conversation --  
that's something we really don't professionally  
don't -- haven't dealt with. 10:26AM

**Q Why haven't you dealt with it?**

A Well, I haven't been in a situation where I  
needed to. We basically -- if there's a situation  
where -- again, my experience goes back to the state  
of Maryland where my firsthand experience is. In 10:26AM  
that case, the State Department of Agriculture  
decided that if we're going to encourage transport  
of litter from one farm to another farm, that the  
best way to do that would be to offer a subsidy to  
subsidize the cost of that, and my understanding is 10:26AM

52

1 A Well, I think it's both sources of funds  
2 subsidize moving the litter. I don't think one load  
3 is paid by one party and another load paid by  
4 another party.

5 **Q But the total program is funded in part by** 10:24AM  
6 **taxpayers and in part by the integrators?**

7 A As I understand it, yes.

8 **Q Okay. In your profession, Dr. Coale, does**  
9 **your focus on farm management decisions --**

10 A Uh-huh. 10:24AM

11 **Q -- keep you from thinking about the**  
12 **advisability of having integrators take**  
13 **responsibility for the litter?**

14 MR. McDANIEL: Object to the form, calls  
15 for a legal conclusion. 10:24AM

16 **Q You can answer.**

17 A No, it does not preclude that.

18 **Q So what have you done to consider the**  
19 **advisability of the integrators moving the litter?**

20 MR. McDANIEL: Object to the form, calls 10:24AM  
21 for a legal conclusion.

22 A I've done nothing in that area.

23 **Q What about your profession generally?**

24 MR. McDANIEL: Same objection.

25 A My profession generally is trying to assess 10:25AM

51

that state agency negotiated with the poultry  
companies to say, hey, listen, will you help us pay  
for this, and the answer was yes. It didn't involve  
the scientists and didn't involve the researchers.  
It was basically a policy decision at state 10:27AM  
management level.

**Q In your profession, Dr. Coale, you do consider**  
**the economics of the farm?**

A Yes.

**Q Why don't you consider the economics of the** 10:27AM  
**integrators?**

A In my profession as a soil scientist, nutrient  
management specialist, I'm looking at -- my primary  
role, vision is at the farm level. I'm sure there  
are agricultural economists who worry about 10:27AM  
industry-wide ramifications and financial  
ramifications. It's just something I haven't dealt  
with.

**Q Aren't there soil scientists that think about**  
**things like that, too?** 10:28AM

A I'm sure there are.

**Q What do they think about it?**

MR. McDANIEL: Object to the form.

A I don't know.

**Q But in your devising and working with the** 10:28AM

53



1 phosphorus index --  
 2 A Uh-huh.  
 3 Q -- you don't even consider the appropriateness  
 4 of having the integrators take responsibility for  
 5 the waste and move it where it might be the most 10:28AM  
 6 efficient and effective use?  
 7 MR. McDANIEL: Object to the form. It's  
 8 asking the witness to render an opinion that's  
 9 something for the court to decide.  
 10 A That wasn't part of my thoughts. 10:28AM  
 11 Q And that's not part of your profession's  
 12 thoughts in using the phosphorus index?  
 13 MR. McDANIEL: Same objection.  
 14 A Speaking broadly about my profession, that  
 15 profession of soil scientists, nutrient management 10:29AM  
 16 specialists, generally, broadly, no.  
 17 Q I think we kind of touched on this, Dr. Coale,  
 18 but on Page 4, Subparagraph I, you tell us that the  
 19 primary reason farmers apply poultry litter to  
 20 pastures is as source of plant-available nitrogen; 10:29AM  
 21 is that right?  
 22 A That's correct.  
 23 Q I think we pretty much agreed to that. And  
 24 that nitrogen is the macronutrient that is required  
 25 in relatively large quantities by grass forage 10:29AM  
 54

1 plants; is that correct?  
 2 A Correct.  
 3 Q Okay. Then you say, for some farmers poultry  
 4 litter is a readily available and cost effective  
 5 course of nitrogen fertilizer that enhances forage 10:29AM  
 6 grass production and permits increased capacity to  
 7 feed and grow pasture-grazed beef cattle; right?  
 8 A Correct.  
 9 Q For what farmers is it a cost effective source  
 10 of nitrogen? 10:30AM  
 11 A For the farmer where the cost of spreading the  
 12 litter that he has on his property is less than the  
 13 cost of purchasing commercial fertilizer at that  
 14 same nitrogen-supplying rate.  
 15 Q Are there other farmers for which it's not a 10:30AM  
 16 cost effective source of nitrogen?  
 17 A If the farmer doesn't have litter on the  
 18 property or very close by and would be -- would have  
 19 to bear the cost of shipping it in from somewhere  
 20 else to utilize, it may be cheaper for him to 10:30AM  
 21 utilize urea or other purchased fertilizer.  
 22 Q Okay. What do you know about efforts to  
 23 transport litter out of the Illinois River  
 24 watershed?  
 25 A I haven't looked into that. 10:31AM

55

Q Okay. You don't know anything at all about  
 litter hauling out of the watershed?  
 A I don't know what is being proposed or what's  
 being done.  
 Q Okay. So it would be fair to say you won't 10:31AM  
 offer any opinion on that at trial?  
 A No, I don't expect to.  
 Q Okay. Turning the page to Page 5 at  
 Subparagraph J, Dr. Coale, why did you tell us that  
 elemental phosphorus does not exist as an isolated 10:32AM  
 element in nature?  
 A Basically because some folks get confused with  
 what phosphorus forms exist in nature, and that's  
 just to clarify that elemental P doesn't.  
 Q Who is confused about that? 10:52AM  
 A Over my years with talking to various  
 individuals, some people from farmers to policy  
 makers to advisors.  
 Q Okay, and you agree with what Dr. Johnson says  
 about that in 3F, his report as indicated here? 10:52AM  
 A Right. I said that I agreed with that  
 statement.  
 Q All right. What's phosphoric acid?  
 A It's an acid that contains phosphorus.  
 Q Okay, and why are you mentioning it here? 10:52AM  
 56

A You are talking Subparagraph K?  
 Q Yes, sir. I'm sorry.  
 A Again, because over the years people talk  
 about phosphoric acid and phosphorus interchangeably  
 with other forms of phosphorus, and it's just to 10:52AM  
 help clarify what exists and what doesn't.  
 Q Okay. What's the significance in Paragraph L  
 there of saying that that list of substances are not  
 typically contained in commercial poultry litter?  
 A I was asked to review the list that Roger 10:52AM  
 Olsen presented in his materials that I've  
 referenced here, and looking at that list that he  
 presented, based on my experience and recollection  
 of literature, et cetera, those items I listed below  
 there were entries that I had not counted being part 10:52AM  
 of normal poultry litter samples.  
 Q And so you are just taking issue with what Dr.  
 Olsen said about that?  
 A Right.  
 Q Okay. Let me show you what has -- I've just 10:52AM  
 marked as Plaintiff's Exhibit 2.  
 MR. NANCE: And since this has a Bates  
 number on it, Scott, I'm not going to bother to  
 write that.  
 Q This is something that was in your considered 10:52AM

57

1 materials, was it not?  
 2 A I believe it was.  
 3 Q How did you come to have -- this was  
 4 originally a PowerPoint, wasn't it?  
 5 A I believe it was. 10:52AM  
 6 Q And I've printed it off here so we can look at  
 7 it today. How did you come to have this PowerPoint?  
 8 A I can't honestly say I can remember. It was  
 9 part of a large package of materials that were  
 10 reported to me when I first was trying to get up to 10:52AM  
 11 speed before the PI hearing.  
 12 Q And what was in that package of materials  
 13 besides this PowerPoint?  
 14 A I don't recall. Materials came in in several  
 15 batches, and I don't recall what else was in there, 10:52AM  
 16 what came when.  
 17 Q Was there any material that you looked at that  
 18 has not been provided us as part of your considered  
 19 materials?  
 20 A Not that I'm aware of. 10:52AM  
 21 Q Do you know Dr. Joern and Dr. Moore?  
 22 A Yes, I do.  
 23 Q Who is Dr. Joern, J-O-E-R-N?  
 24 A Dr. Joern, that's pronounced correctly. He's  
 25 a professor at Purdue University. 10:52AM

58

1 Q And how well do you know him; how did you come  
 2 to know him?  
 3 A Professionally we were working in a lot of the  
 4 same areas, and I've known him for probably fifteen  
 5 years. 10:52AM  
 6 Q What about Dr. Moore?  
 7 A Same answer.  
 8 Q Is he also at Purdue?  
 9 A No. He's with the USDA.  
 10 Q And where does he work? 10:52AM  
 11 A At University of Arkansas.  
 12 Q What significance did this PowerPoint have in  
 13 your preparation to testify?  
 14 A Honestly, not much. I think this is something  
 15 I probably looked through and then put it away. 10:52AM  
 16 Q Do you anticipate offering testimony at trial  
 17 on any question about phosphorus being a hazardous  
 18 waste or not being a hazardous waste?  
 19 A No, sir.  
 20 Q Do you know who will offer any such testimony 10:52AM  
 21 on behalf of the defense?  
 22 A No, I'm not aware of who would, if anyone  
 23 would.  
 24 Q Do you know who might offer such testimony?  
 25 A No, I don't. 10:52AM

59

Q Dr. Coale, we have talked about producers of  
 litter in the Illinois River watershed.  
 A Uh-huh.  
 Q Do you know what percentages of the producers  
 of litter, I mean people who own the houses, in the 10:52AM  
 Illinois River watershed apply litter on their own  
 land?  
 A I don't know that.  
 Q Okay. Do you know if anyone on behalf of the  
 defendants knows that? 10:52AM  
 A I'm not aware.  
 Q Okay. Have you determined, Dr. Coale, how  
 much land in the Illinois River watershed -- what's  
 our magic word -- could receive litter without any  
 other restrictions applying, pastureland? 10:52AM  
 A No, I have not.  
 Q Do you know if anyone has determined that on  
 behalf of the defendants?  
 A I know that Dr. Dicks did an estimation, and I  
 reviewed that estimation, and all I could conclude 10:52AM  
 was that the methodology and logic he used in  
 producing in his estimation, I found to be sound.  
 Q We can get to that later. Are you in a  
 position to say his estimation is true and correct?  
 A Numerically, no. 10:52AM

60

Q Dr. Coale, have you determined how much land  
 there is in the Illinois River watershed,  
 pastureland, which has no other restrictions that  
 would apply, for which the owners of that land want  
 litter but can't get it? 10:52AM  
 A No. I've not been involved in that.  
 Q Okay. I'm kind of asking about an unmet  
 demand for litter.  
 A Right.  
 Q Do you know if anyone on behalf of the 10:52AM  
 defendants has determined that or is trying to  
 determine that?  
 A Not that I know of.  
 Q Okay. Have you determined, Dr. Coale, the  
 amount of land in the Illinois River watershed for 10:52AM  
 which other restrictions don't apply where there is  
 an unmet demand for litter but which has an STP  
 below 65?  
 A No.  
 Q And if I give you any other STP I want, would 10:52AM  
 the answer be the same?  
 A It would be the same.  
 Q So if I ask you about 100 STP, it would be the  
 same answer?  
 A I don't have any acreage estimates of any of 10:52AM

61

1 those kind of scenarios.

2 **Q Has anyone from the defense determined such an**

3 **estimate?**

4 A Not that I know of.

5 **Q Okay. For 65 or 100 or any other STP? 10:52AM**

6 A Not that I'm aware.

7 **Q Okay.**

8 MR. ELROD: Can we do a timeout?

9 MR. NANCE: Yes.

10 (Whereupon, a discussion was held off 10:52AM

11 the Record.)

12 **Q Nitrogen is typically the largest input**

13 **nutrient required for management of pasture grasses;**

14 **is that correct?**

15 A Typically, yes. 10:52AM

16 **Q Particularly in pasture-grazed beef**

17 **production?**

18 A Typically, yes.

19 **Q What's the ratio typically in this watershed**

20 **between the need for nitrogen and the need for 10:52AM**

21 **phosphorus in those pasture grasses?**

22 A Well, speaking generally in pasture grasses in

23 general, it's somewhere between six to eight times

24 more nitrogen than phosphorus.

25 **Q Okay. Now, you say -- in 4B at the bottom of 10:52AM**

6 2

1 **Page 5, you say historically litter applications to**

2 **grass pastures usually have been based on N**

3 **fertilization rates. We talked about that a minute**

4 **ago; do you remember that?**

5 A Correct. 10:52AM

6 **Q So that's correct?**

7 A Yes.

8 **Q Then you say, even if soil test P levels are**

9 **adequate, N must be applied to maintain pasture**

10 **productivity; right? 10:52AM**

11 A Yes.

12 **Q At the top of Page 6 in that same subparagraph**

13 **you say, recently enacted regulations -- this is the**

14 **third line down -- that limit poultry litter**

15 **applications to P-based rates can create scenarios 10:52AM**

16 **in which farmers and ranchers may no longer be able**

17 **to meet the total N needs for the forage crop from**

18 **poultry litter applications. Do you see that?**

19 A Uh-huh.

20 **Q What do you mean by that, sir? 10:52AM**

21 A If the litter application rate is limited

22 based on the maximum litter that can be applied

23 under what is known as a P-based rate, a

24 phosphorus-based rate, then that amount of litter

25 may be applied, but that amount of litter, which is 10:52AM

6 3

a reduced rate, may not contain enough

plant-available nitrogen to give the forage crop all

the nitrogen it needs to reach maximum productivity.

So if you want to reach maximum productivity, you'd

have to supplement with another source of nitrogen, 10:52AM

probably a purchased fertilizer nitrogen.

**Q Why have these recently enacted regulations**

**done that to farmers?**

A Speaking generally?

**Q Generally. 10:52AM**

A Most -- the regulations that I'm aware of

across the country typically fall into -- the

guidance that comes out of the recommendations

typically falls into three different categories.

One is you apply the manure at the, quote, normal or 10:52AM

historic rate, which would be the nitrogen-based

rate, and there's a middle category that says apply

it at a phosphorus-based rate, which meets the

phosphorus needs of the situation, and a third

category, which would be don't apply any manure at 10:52AM

all.

So before those guidances were enacted --

well, after they had been enacted, then the -- that

P-based rate, that middle scenario, would be this

scenario where you may be able to apply a reduced 10:52AM

6 4

rate of litter but not -- but that reduced rate

wouldn't be supplying all the nitrogen that the crop

needs.

**Q And isn't the reason for the reduced rate an**

**environmental concern? 10:52AM**

A Yes.

**Q Okay. In 4C there on Page 6, Dr. Coale, the**

**second sentence says, root systems of forage grasses**

**accumulate inorganic soluble P from deep below the**

**soil surface and convert it to organic P in the 10:52AM**

**aboveground tissues of the forage grass. How deeply**

**do the root systems draw that organic P -- inorganic**

**P? Excuse me.**

A Well, that's a very general statement. It

really depends on the crop that's being grown, what 10:52AM

the crop species is and the soil it's being grown

on.

**Q Let's talk about forage grasses.**

A Forage grasses.

**Q Particularly in the IRW, if you know 10:52AM**

**specifically.**

A Well, forage grasses in general, there would

be rooting depths down to maybe 24 inches maximum,

something like that.

**Q From how far down do they draw phosphorus? 10:52AM**

6 5

1 A Phosphorus is usually taken up at the root  
2 tips, so it would be all the way down to the depth.  
3 **Q So if that's the case, why do we put**  
4 **phosphorus on the surface?**  
5 A Because there are a lot of roots near the 10:52AM  
6 surface, especially of a grass plant. They can root  
7 deeply, but they also root laterally very profusely.  
8 So if phosphorus is put on the soil surface and as  
9 it works its way into the soil, the roots have  
10 access to it, even at the shallow depth. 10:52AM

11 **Q Do forage grasses get most of their phosphorus**  
12 **from shallow depths or from two feet down?**  
13 A I don't know if I can answer that answer. I  
14 don't know.  
15 **Q Okay. Do they get most of their nitrogen at a** 10:52AM  
16 **shallow depth or from two feet down?**

17 A Probably the same. I don't know what depth  
18 they would get most of it from.  
19 **Q Where does the phosphorus that's two feet down**  
20 **come from, particularly where litter is applied?** 10:52AM  
21 A Well, some of it could be native to the soil.  
22 There are some soils which have substantial  
23 phosphorus with depth, especially if the rock  
24 material it developed from has phosphorus materials  
25 in it. Phosphorus can move slowly down through the 10:52AM

66

1 soil, and that rate of movement downward is varied  
2 depending on the chemistry and the type of soil that  
3 we're talking about at that location.  
4 **Q What can you tell me about the chemistry in**  
5 **the soil in the Illinois River watershed?** 10:52AM  
6 A Specifically, I haven't studied it.  
7 **Q Has anybody studied it for the defendants that**  
8 **you know of?**  
9 A I haven't talked to anyone who has.  
10 **Q How much of the phosphorus that is in the** 10:52AM  
11 **forage grasses in the Illinois River watershed where**  
12 **litter is applied comes from the litter versus comes**  
13 **from the native soil?**

14 MR. McDANIEL: Object to the form.  
15 MR. ELROD: Do we need to stop for a  
16 second?  
17 MR. NANCE: Let's take a quick break.  
18 COURT REPORTER: I just need to plug in.  
19 A Could you repeat the question, please?  
20 (Whereupon, the court reporter read 10:52AM  
21 back the previous question.)  
22 A Well, the simple answer is that all of it  
23 comes from the soil, but I don't know where the  
24 original source of the phosphorus was. A plant  
25 can't take up phosphorus straight from litter. It 10:52AM

67

has to become part of the soil before it can take it  
up.  
**Q And the simple answer may be too simple in**  
**this case; right?**  
MR. McDANIEL: Object to the form. 10:52AM  
**Q We know that when we put down litter, we know**  
**we're putting phosphorus onto the soil; correct?**  
A Correct.  
**Q And we're doing that in order for the**  
**phosphorus -- if we care about phosphorus so the** 10:52AM  
**phosphorus can be available to the plants; right?**  
A Correct.  
**Q I guess if we don't care about the phosphorus,**  
**we don't -- it doesn't matter, does it; if we're** 10:52AM  
**just using nitrogen and there's already enough**  
**phosphorus in the soil, we don't care where it comes**  
**from?**

MR. McDANIEL: Object to the form.  
A It's going to come with the litter  
application, but if your original question was what 10:52AM  
percentage of the phosphorus taken up by a forage  
grass plant comes from native phosphorus of a soil  
origin and what phosphorus would come from past  
litter applications, I can't answer that question.

**Q You say at the bottom of Subparagraph C,** 10:52AM

68

**manure phosphorus that is deposited onto the soil**  
**surface by grazing cattle is subject to a variety of**  
**fates including --**  
A Let me catch up with you, please.  
Subparagraph C? 10:52AM

MR. McDANIEL: Yeah, last sentence.  
**Q Do you see where we are?**  
**MS. HILL: 4C.**  
**Q 4C at the top of the page.**  
A I'm not on the C. Yes, I see it now.  
**Q Manure phosphorus is subject to a variety of**  
**fates, including recycled uptake by pasture plants**  
**and transportation with surface runoff and leaching**  
**waters; do you see that?**

A Yes. 10:53AM  
**Q Let's talk about that a minute. Some of the**  
**phosphorus, do I have it correctly, that is in**  
**cattle manure returns and is recycled into more**  
**grass; right?**

A Correct. 10:53AM  
**Q And the same thing with poultry litter that's**  
**applied on the same field?**  
A Correct.

**Q Okay. Some of the phosphorus that is applied**  
**from cattle manure is subject to surface runoff?** 10:54AM

69

1	A Potentially, yes.			of corn, for example, that are blended in now. Some	
2	<b>Q As is phosphorus from poultry litter?</b>			of them have a much higher available level of	
3	A Potentially, yes.			phosphorus than historically. So maybe it's less of	
4	<b>Q Okay, and some of it is subject to leaching</b>			a practice now, but I don't know if it's -- what	
5	<b>into the ground, the cattle phosphorus as well as</b>	10:54AM		percent decrease has been or anything.	10:57AM
6	<b>the chicken phosphorus?</b>			<b>Q Do you know anything about the specific</b>	
7	A Potentially, yes, that can happen.			<b>enrichment of feed in the Illinois River watershed?</b>	
8	<b>Q All right. Dr. Coale, how much of the grain</b>			A No, I don't.	
9	<b>that goes into poultry feed in the Illinois River</b>			<b>Q Okay. Dr. Coale, stepping back for a minute,</b>	
10	<b>watershed is grown in the Illinois River watershed?</b>	10:54AM		<b>is it your testimony that none of the phosphorus</b>	10:57AM
11	A I don't know.			<b>that goes into poultry feed in the Illinois River</b>	
12	<b>Q Do you know if any is?</b>			<b>watershed and comes out in poultry waste ever gets</b>	
13	A My understanding is a small amount.			<b>to the water in the Illinois River watershed?</b>	
14	<b>Q Okay. Typically in these concentrated growing</b>			MR. McDANIEL: Object to the form.	
15	<b>operations, the feed comes from somewhere else,</b>	10:55AM		A I don't think you can ever say absolutely	10:58AM
16	<b>doesn't it?</b>			none.	
17	A Typically, yes, my understanding it does.			<b>Q So would you be scientifically comfortable</b>	
18	<b>Q Okay. Do you know in absolute terms how much</b>			<b>with the proposition that some of that phosphorus</b>	
19	<b>is imported into the watershed, feed, grain?</b>			<b>that is in the feed and then goes into the waste</b>	
20	A No, I don't.	10:55AM		<b>gets into the water in the Illinois River watershed?</b>	10:58AM
21	<b>Q Do you know in relative terms how much feed,</b>			MR. McDANIEL: Object to the form.	
22	<b>grain is imported into the watershed?</b>			A I'd say potentially that's possible.	
23	A No, I don't.			<b>Q Well, a lot of things are potentially</b>	
24	<b>Q Do you know if the defendants blend the feed</b>			<b>possible. Are -- as a scientist, are you prepared</b>	
25	<b>they use in the watershed in or about the watershed;</b>	10:55AM		<b>to say that some of it does get in the water in the</b>	10:58AM
	70			72	
1	<b>do you know where it's blended and distributed from?</b>			<b>Illinois River watershed?</b>	
2	A I have no knowledge of that.			MR. McDANIEL: Object to the form, asked	
3	<b>Q Is the grain that's used in poultry litter</b>			and answered.	
4	<b>typically enriched with more phosphorus?</b>			A No. I can't -- I have no knowledge of	
5	MR. McDANIEL: You say grain used in	10:56AM		phosphorus quantitatively moving anywhere within the	10:59AM
6	poultry litter?			Illinois River watershed.	
7	MR. NANCE: Excuse me. Poultry feed,			<b>Q You don't know anything about phosphorus</b>	
8	you're right.			<b>moving in the watershed?</b>	
9	A I know, again, based on my knowledge of			A I said quantitatively.	
10	poultry production on the eastern shore, the	10:56AM		<b>Q Okay. Tell me what you mean when you say</b>	10:59AM
11	Delmarva and Maryland area, it used to be very			<b>quantitatively.</b>	
12	common practice, and now I believe it's less common.			A If you asked me can one pound move from a	
13	It probably is in some cases and is not in other			poultry farm into an adjacent body of water, can two	
14	cases. I don't know.			pounds, can three pounds move, I don't know. I can	
15	<b>Q Why was it done?</b>	10:56AM		talk about the -- how we understand that the	10:59AM
16	A Historically it was believed that there was			mechanisms work and how we understand how the	
17	not enough available phosphorus in the grains			nutrients move in the landscape, but I don't have	
18	available to the plant -- excuse me, available to			any information on quantitative pounds of delivery	
19	the bird to give the bird a healthy diet, so they			to the water.	
20	would add it.	10:56AM		<b>Q Okay, and I'm not asking you to name a</b>	10:59AM
21	<b>Q Okay, and is that no longer the understanding?</b>			<b>specific quantity.</b>	
22	A I think we're in a transition phase and,			A Okay.	
23	again, poultry nutrition is not my area of			<b>Q But to a reasonable degree of scientific</b>	
24	expertise, but my understanding is there are			<b>certainty, you can say, can you not, that some of</b>	
25	advances in diet formulations and the specific types	10:57AM		<b>that phosphorus gets into the water in the Illinois</b>	11:00AM
	71			73	

1	<b>River watershed?</b>		<b>rains and there's runoff --</b>	
2	MR. McDANIEL: Object to the form. Third		A Uh-huh.	
3	time on that question.		<b>Q -- there's also an increased concentration of</b>	
4	A The water that leaves any watershed -- water		<b>soluble phosphorus because the STPs are elevated;</b>	
5	that starts from rainfall and moves through a soil,	11:00AM	<b>right?</b>	11:02AM
6	over a soil, across the landscape and into a water		A Typically when you have elevated soil test	
7	body is going to be carrying some phosphorus with		phosphorus levels, there's elevated soluble	
8	it. So if it moves through one of these sites where		phosphorus levels, yes, in the soil.	
9	litter has been applied, that water when and if it		<b>Q So even if it rains on a site where the</b>	
10	reaches a water body will have some level -- large	11:00AM	<b>defendants' waste has elevated the STP, even though</b>	11:03AM
11	or small, I don't know -- some level of phosphorus		<b>there's no litter on it right now, fresh litter --</b>	
12	in it.		A Right.	
13	<b>Q Okay. So some of that phosphorus in the water</b>		<b>Q -- it's going to run off with some of the</b>	
14	<b>originates with the defendants' waste, poultry</b>		<b>phosphorus that originated with the defendants'</b>	
15	<b>waste?</b>	11:00AM	<b>waste; right?</b>	11:03AM
16	MR. McDANIEL: Object to the form.		MR. McDANIEL: Object to the form.	
17	A I don't know.		A If runoff is generated.	
18	<b>Q Some? You don't know?</b>		<b>Q Right.</b>	
19	A No, I don't.		A And that's the premise you've got to	
20	<b>Q Really?</b>	11:01AM	understand, that if runoff is generated from a site	11:03AM
21	MR. McDANIEL: Move to strike.		and there is an elevated soil test level phosphorus	
22	<b>Q Well, you know there's a lot of poultry waste</b>		at that site, then that runoff will be carrying	
23	<b>land applied in the Illinois River watershed; right?</b>		phosphorus with it.	
24	A Correct.		<b>Q Okay. Have you looked at the data that shows</b>	
25	<b>Q And I'm not asking you to vouch for 200,000</b>	11:01AM	<b>that phosphorus transports spikes after a big rain?</b>	11:03AM
	74		76	
1	<b>tons or 300,000 tons or 400,000 tons, but there's a</b>		MR. McDANIEL: Object to the form.	
2	<b>lot?</b>		<b>Q In the Illinois River watershed?</b>	
3	A There's some applied, yes, sir.		MR. McDANIEL: Object to the form.	
4	<b>Q Okay, and when it goes on the ground, that</b>		A No, sir.	
5	<b>litter goes on the ground and it rains on that</b>	11:01AM	<b>Q Okay. Would that surprise you if I</b>	11:03AM
6	<b>litter, if there's runoff from that site, there will</b>		<b>represented to you that that happens?</b>	
7	<b>be soluble phosphorus in it?</b>		MR. McDANIEL: Object to the form. You're	
8	A If runoff is generated, yes, there will be		going to have to show him the data.	
9	phosphorus in that runoff.		A Okay. Following a rainfall event in the	
10	<b>Q Okay, and there may also be erosion or</b>	11:01AM	Illinois River watershed, I don't know if that	11:04AM
11	<b>particulate phosphorus runoff from that site?</b>		happens or not.	
12	A There could be, yes.		<b>Q Do you know if it happens anywhere in the</b>	
13	<b>Q Okay. That's a common mechanism --</b>		<b>world that litter has been used that phosphorus runs</b>	
14	A Correct.		<b>off after a big rain?</b>	
15	<b>Q -- in the literature known to your profession?</b>	11:01AM	A Generally the first or second rainfall event,	11:04AM
16	A Correct.		after a manure application to the surface of the	
17	<b>Q And you know that STPs in the Illinois River</b>		soil, has more elevated phosphorus in runoff if	
18	<b>watershed are elevated because of that land</b>		runoff is generated than subsequent rainfalls.	
19	<b>application of poultry litter; right?</b>		<b>Q All right. What stops that elevated</b>	
20	MR. McDANIEL: Object to the form.	11:02AM	<b>phosphorus in the runoff from getting into the</b>	11:04AM
21	A We talked about this earlier, that I believe		<b>streams and creeks and river of the Illinois River</b>	
22	from the data I've seen and what I've learned, that		<b>watershed?</b>	
23	some sites are.		A What stops it from getting there?	
24	<b>Q Okay, and so in addition to the phosphorus</b>		<b>Q Well, you say you don't know that any of it</b>	
25	<b>from the litter itself laying on the ground if it</b>	11:02AM	<b>gets to the Illinois River watershed.</b>	11:05AM
	75		77	



1 A Well, you don't know -- if you're looking at a  
2 particular field and if there's runoff generated  
3 from that field, you don't -- I don't know from a  
4 very -- without looking at a specific site whether  
5 there's any kind of activity between that field and 11:05AM  
6 the receiving water body. That runoff water that's  
7 generated from that field and can be measured in  
8 that field and we can talk about that phosphorus  
9 content in that runoff generated from that field, I  
10 don't have knowledge about where that runoff ends 11:05AM  
11 up. It may never make it to the water body or it  
12 might. I don't know.  
13 **Q What would it take for you to have knowledge?**  
14 A We would have to know what the conveyance and  
15 the conductivity from that application site where 11:05AM  
16 that runoff was generated to the receiving water  
17 body.  
18 **Q So you would have to go out there and look; is**  
19 **that what you're telling me?**  
20 A There would have to be, yeah, physical 11:05AM  
21 assessment made.  
22 **Q I mean, by you?**  
23 A If I had the tools to assess it. It may not  
24 be something I can assess.  
25 **Q How many sites are there in the Illinois River 11:06AM**  
78

1 watershed where the STP has been elevated by the  
2 application of poultry waste?  
3 MR. McDANIEL: Object to the form.  
4 A How many you say?  
5 MR. McDANIEL: Object to the form. 11:06AM  
6 A I don't know.  
7 **Q A thousand?**  
8 A I don't know.  
9 **Q How many poultry farms are there in the**  
10 **Illinois River watershed? 11:06AM**  
11 A I don't know.  
12 **Q You have no knowledge of that at all?**  
13 A I have paid no attention to the number of  
14 farms, the number in the watershed. I just don't  
15 know that number. 11:06AM  
16 **Q Do you know how many birds have been raised**  
17 **there?**  
18 A I've read it but I don't -- it wasn't  
19 important to what I was trying to learn.  
20 **Q Did you look at the data that Gordon Johnson 11:06AM**  
21 **looked at?**  
22 A I looked at some of the data he did, yes.  
23 **Q Hundreds of sites with elevated STPs in the**  
24 **watershed?**  
25 MR. McDANIEL: Object to the form. 11:06AM  
79

**Q Does he have data that shows hundreds of sites**  
**with elevated STP in the watershed?**  
MR. McDANIEL: Object to the form.  
A I would not say hun -- there were several,  
many sites in the locations in the spreadsheet data 11:07AM  
that I looked at that were elevated.  
**Q Would it be thousands?**  
A I don't recall. I don't recall how many total  
were, and I don't recall how many percent of that  
were total elevated. 11:07AM  
**Q Where does the water in the Illinois River and**  
**its tributaries come from?**  
A Rainfall.  
**Q And does the rainfall fall on the surface of**  
**the earth? 11:07AM**  
A Yes, it does.  
**Q Have you ever seen it in the Illinois River**  
**watershed?**  
A Have I ever -- my own eyes?  
**Q Yeah. 11:07AM**  
A I don't think I've ever been to the Illinois  
River watershed.  
**Q So are you comfortable assuming that it rains**  
**in the Illinois River watershed?**  
A I'm comfortable that it rains there, yes, sir. 11:07AM  
80

**Q Okay, and are you comfortable that the water**  
**in the watershed comes from rain?**  
A Yes, sir.  
**Q And that rain falls down?**  
A Yes, sir. 11:08AM  
**Q Are you comfortable that water flows downhill?**  
A Yes, sir.  
**Q Even though you haven't seen it in the**  
**Illinois River watershed?**  
A Yes, sir. 11:08AM  
**Q Okay, and you know the mechanisms of**  
**phosphorus transport; right?**  
A I understand those, yes.  
**Q Okay. I'm not asking about whether you've**  
**seen it be transported, but are you telling me that 11:08AM**  
**as the expert, you don't know that some of the**  
**defendants' phosphorus makes it into the water in**  
**the Illinois River watershed?**  
MR. McDANIEL: Object to the form, asked  
and answered. 11:08AM  
A I have no way of determining of the phosphorus  
that makes it to the water body, where that  
phosphorus came from. That is beyond my area of  
expertise, and I just don't know.  
**Q Well, you teach environmental science, don't 11:09AM**  
81

1	you?		of that phosphorus was by any tools that I'm aware	
2	A Yes, sir.		of. Once it becomes part of that soil phosphorus	
3	<b>Q And you teach about phosphorus indices?</b>		pool, I don't know of a mechanism or a procedure or	
4	A Yes, sir.		process or technique to identify where that	
5	<b>Q And you know about the transport methods for phosphorus, don't you?</b>	11:09AM	phosphorus originally originated from. That's why	11:12AM
6			I'm saying I can't tell you whether one pound, ten	
7	A Yes, sir.		pounds, zero pounds or whatever of litter-originated	
8	<b>Q So what about that is beyond your area of expertise?</b>		phosphorus ended up in that runoff water.	
9			<b>Q To what extent is it a scientifically</b>	
10	A There are multiple sources of phosphorus in this watershed.	11:09AM	<b>defensible conclusion, that given the history of</b>	11:12AM
11			<b>this watershed, none of the phosphorus that came</b>	
12	<b>Q Well, I'm sorry. Answer my question and tell me what about that is beyond your area of expertise.</b>		<b>through the defendants' chickens or turkeys has made</b>	
13			<b>it to the water?</b>	
14	A Of what you just outlined, nothing.		MR. McDANIEL: Object to the form,	
15	<b>Q So within your area of expertise, why can't you grant that some of the defendants' phosphorus gets into the water?</b>	11:09AM	mischaracterizes his testimony.	11:12AM
16			A It wouldn't be very scientifically defensible	
17			to say that none of it did.	
18	MR. McDANIEL: Bob, you are arguing with		MR. NANCE: Let's go ahead and change	
19	the witness now. This is the tenth time on this		tapes.	
20	question.	11:10AM	VIDEOGRAPHER: We're now off the Record.	11:13AM
21	A I don't know where the phosphorus that's in		The time is 11:14 a.m.	
22	any hypothetical runoff event that occurred in the		(Following a short recess at 11:14	
23	watershed, where it originated. It could have been		a.m., proceedings continued on the Record at 11:26	
24	from fertilizer applied to that field. It could		a.m.)	
25	have been from manure applied to that field. It	11:10AM	VIDEOGRAPHER: We are back on the Record.	11:25AM
	82		84	
1	could have been from cattle manure applied to that		The time is 11:26 a.m.	
2	field. I don't know.		<b>Q Dr. Coale, to your knowledge, will any expert</b>	
3	<b>Q My question isn't about fertilizer or cattle manure. It's about chicken litter, chicken waste.</b>		<b>on behalf of the defendants testify that none of the</b>	
4			<b>phosphorus from defendants' poultry waste makes it</b>	
5	A Uh-huh.	11:10AM	<b>into the water of the Illinois River watershed?</b>	11:25AM
6	<b>Q And knowing what you know about phosphorus transport and rainfall, don't you know that some of it gets in the water?</b>		A I don't have any knowledge of that plan. I	
7			don't know.	
8			<b>Q In your report, sir, Paragraph 5 is generally</b>	
9	MR. McDANIEL: Object to the form. Hold		<b>entitled concern about high P soils. That starts on</b>	
10	on, Frank. If you keep asking this question time	11:10AM	<b>Page 6. Do you see that?</b>	11:26AM
11	and time again, I'm going to call the judge. He's		A Yes, I do.	
12	answered the question and he's answered it. Now		<b>Q What is the concern about high phosphorus</b>	
13	it's becoming oppressive, and you're just beating on		<b>soils?</b>	
14	him, and I don't think it's appropriate. There will		A A general explanation is there's some concern	
15	be a point at which I'm going to instruct him not to	11:10AM	that as soils become enriched, become high P by	11:26AM
16	answer and we'll call the judge.		whatever definition there is for a high P soil, that	
17	A When phosphorus is introduced into a soil,		the potential for movement off site with runoff	
18	regardless of where it originated from, it becomes		water can be elevated.	
19	part of the soil phosphorus pool. Okay? That soil		<b>Q And do we care about the potential for runoff</b>	
20	phosphorus in that -- that phosphorus in that soil	11:11AM	<b>from the site because it could have bad</b>	11:26AM
21	pool is subject to being taken up by plants, being		<b>environmental consequences?</b>	
22	fixed chemically or physically fixed within the		MR. McDANIEL: Object to the form.	
23	soil, moving with soil water in lateral or vertical		A If the runoff reaches a water body, yes, it	
24	directions. When you measure phosphorus in runoff		could.	
25	of a field, you can't tell what the original source	11:11AM	<b>Q Okay, and does the runoff reach water bodies</b>	11:26AM
	83		85	

1 often enough that we are, in fact, concerned about  
 2 it environmentally?  
 3 MR. McDANIEL: Object to the form.  
 4 A Yes, there is a concern.  
 5 **Q But does runoff reach water enough that it 11:26AM**  
 6 **give us a real concern?**  
 7 MR. McDANIEL: Object to the form.  
 8 A I believe it does.  
 9 **Q In your preparation -- let me take a short**  
 10 **detour here, Dr. Coale. In your preparation to 11:27AM**  
 11 **testify, have you talked with anyone at an agency of**  
 12 **the State of Oklahoma?**  
 13 A Not that I'm aware.  
 14 **Q Okay. Have you looked at any soil test data**  
 15 **besides that that was used by Dr. Johnson, Gordon 11:27AM**  
 16 **Johnson?**  
 17 A I don't believe so.  
 18 **Q Have you been made aware of the results of any**  
 19 **environmental sampling conducted by the defendants?**  
 20 A Can you define environmental sampling? 11:28AM  
 21 **Q Probably not. Any sampling, any test of the**  
 22 **environment whatsoever --**  
 23 A No, no.  
 24 **Q -- by the defendants.**  
 25 A No. I haven't paid attention to it. If I've 11:28AM

86

1 seen it, I've dismissed it.  
 2 **Q Okay. In Paragraph 5B on Page 6 you say that**  
 3 **it's important to remember that there's always some**  
 4 **potential background level of P that may be 11:28AM**  
 5 **transported off field with field drainage water; do**  
 6 **you see that?**  
 7 A Yes, sir.  
 8 **Q And that would be true even if there had never**  
 9 **been any commercial fertilizer or poultry waste**  
 10 **applied to the field; right? 11:28AM**  
 11 A True.  
 12 **Q Okay, and in any ecosystem that includes soil,**  
 13 **there's no such thing as zero phosphorus discharge;**  
 14 **is that right?**  
 15 A From my understanding, that's true. 11:29AM  
 16 **Q Okay. Dr. Coale, is there any circumstance**  
 17 **where land application of poultry waste would not**  
 18 **elevate the STP?**  
 19 A I'm trying to think of -- when you preface is  
 20 there any such thing, I'm trying to think of some 11:29AM  
 21 unusual or manipulative situation, but I can't off  
 22 the top of my head. So I would say under normal  
 23 farm management application, no, the STP would go  
 24 up.  
 25 **Q Tell me very quickly what you mean when you 11:29AM**

87

say STP or soil test phosphorus.  
 A That's a good point. Soil test phosphorus is  
 a laboratory method of measuring a certain quantity  
 of soil -- excuse me, a certain quantity of  
 phosphorus in the soil to be used as a predictor for 11:30AM  
 phosphorus available for growing crops. There's  
 different ways of making that measurement.  
**Q Okay. Is phosphorus the limiting nutrient in**  
**the waters of the Illinois River watershed as**  
**regards algae growth? 11:30AM**  
 MR. McDANIEL: Object to the form. It's  
 outside the scope of his report.  
 A My general understanding is it is, but that's  
 definitely outside my area of expertise.  
**Q Okay. Have you discussed that with any expert 11:30AM**  
**for the defendants?**  
 A No, I haven't discussed any water body data at  
 all.  
**Q Okay. Dr. Coale, have you reviewed any**  
**reports put out by the State of Oklahoma about water 11:31AM**  
**quality in the Illinois River watershed?**  
 A I believe I have reviewed reports. I don't  
 know who produced them. I don't recall that, but  
 some general -- when I was first getting up to speed  
 on this whole situation, I read some background 11:31AM

88

information about what's going on in the watershed,  
 and I don't recall who produced it.  
**Q Is that in the considered materials you sent**  
**us with your report?**  
 A There probably -- I don't know is the bottom 11:31AM  
 line answer. If I didn't -- if that was just  
 background information, I didn't consider it to be  
 part of this report background.  
**Q In Paragraph 5C you say that soil test P**  
**buildup and decline is not elastic. Could you tell 11:32AM**  
**me what you mean by that?**  
 A What I meant by that is that oftentimes as you  
 apply phosphorus to a soil to increase soil test P  
 and then you stop applying, it doesn't come down at  
 the same rate it went up. 11:32AM  
**Q If you apply phosphorus to soil, the STP will**  
**go up?**  
 A Correct.  
**Q Okay. Is that true whether it's commercial**  
**phosphorus or phosphorus from poultry waste? 11:32AM**  
 A That's true.  
**Q Okay. Okay. One of the things that Dr.**  
**Johnson said that you mention in Paragraph 5C is**  
**that -- it's about midway through the part that's on**  
**Page 6. Well, I'll get the whole sentence. 11:33AM**

89

1	A Okay.			A Summary of the results of several studies,	
2	Q Dr. Gordon Johnson stated that historic			yes.	
3	calibration studies determined that applied P that			Q Several studies. Are you aware of any such	
4	is in excess of crop uptake will accumulate in the			studies that were done in the Illinois River	
5	soil and raise the STP about one pound STP per acre	11:33AM		watershed?	11:36AM
6	for every ten to fifteen pounds of excess P205 per			A No, I'm not.	
7	acre, and then you cite to his report.			Q Okay. Have you looked at studies relied upon	
8	A Uh-huh.			by Dr. Johnson for his opinion that it goes down	
9	Q Is that much of what Dr. Johnson said			about as fast as it comes up?	
10	scientifically reasonable for the soils in the	11:33AM		A No. The only information I have from Dr.	11:36AM
11	Illinois River watershed?			Johnson was that one statement that in my	
12	A I think that's being reasonable.			interpretation assumed it came down the same rate it	
13	Q Okay. Now, you disagree about where he says a			went up.	
14	little farther down, similarly, when no P is added,			Q Okay. Let's look at one of these studies that	
15	an STP will decrease by about the same factor. Why	11:34AM		you participated in. Just a moment. Dr. Coale, let	11:36AM
16	do you disagree with it? First of all, do you			me hand you what I've marked as Exhibit No. 3 Coale	
17	disagree with what he said there?			and copies to Mr. McDaniel. Is this one of the	
18	A I disagree that you can assume that it's going			studies that you referred to in Paragraph 5C of your	
19	to come down to the same rate.			report?	
20	Q Okay, and why do you disagree with that?	11:34AM		A Yes, it is.	11:37AM
21	A I believe later on in that paragraph I gave			Q Could you pronounce the name of the lead	
22	several citations to data that has been produced			author for me?	
23	around various places in the country where it shows			A Kratochvil.	
24	that the rate of decline of soil test P after you			Q Kratochvil, and you are the second author	
25	stop adding new phosphorus to the system and	11:34AM		listed on this report; is that correct?	11:38AM
	90			92	
1	continue to grow crops is really highly variable.			A Correct.	
2	Sometimes it comes down quickly and sometimes it			Q So this is something that you did yourself;	
3	doesn't move at all. It stays elevated at whatever			right?	
4	rate it was when it started for many years, and that			A Right. Well, Dr. Kratochvil took the lead in	
5	oftentimes that rate of decline is highly dependent	11:35AM		it, and I was the secondary.	11:38AM
6	on the historical treatment of that land. So to			Q Let's look at the -- what I'm going to call	
7	assume that the soil test P level comes down at the			the summary there at the top of Page 117, the first	
8	same rate it went up with fertilizer addition is			page of that report.	
9	very simplistic, and I don't think it's reliable.			A Yes.	
10	Q Okay. Are you familiar with the term	11:35AM		Q The very first sentence there, let me read it	11:38AM
11	phytoremediation?			and let's talk about it briefly. Eutrophication of	
12	A Yes.			fresh water bodies is frequently attributed to	
13	Q Tell me what that is, please.			elevated phosphorus concentrations in surface runoff	
14	A That's the use of plants to aggressively			from P-enriched agricultural soils. Is that a true	
15	reduce the concentration of usually a contaminant of	11:35AM		statement?	11:38AM
16	some sort in the soil.			A Yes.	
17	Q Okay, and there have been studies, have there			Q Okay. Below where it says introduction, would	
18	not, on phytoremediation on high phosphorus soils?			you read the first -- just the first sentence below	
19	A Yes, there have.			introduction?	
20	Q In fact, you've done at least one study on	11:35AM		A Starting many agricultural fields in	11:39AM
21	that subject yourself, haven't you?			concentrated livestock production regions throughout	
22	A Yes, I have.			the world are characterized by soils that are highly	
23	Q Okay, and was what you told me a minute ago			enriched in phosphorus as a result of either	
24	about it being variable, kind of a summary of the			excessive manure application rates or long-term	
25	results of those studies?	11:35AM		animal manure use.	11:39AM
	91			93	

1 Q Okay. Obviously you agree with that because  
2 that's in the report that you helped write; correct?

3 A Uh-huh, correct.

4 Q Would that be true for the soils in the  
5 Illinois River watershed where poultry waste has  
6 been applied? 11:39AM

7 A I would suspect it is at some sites and maybe  
8 not at all sites.

9 Q Okay, and you go on to say, as we've talked  
10 about before, rates for manure application are  
11 typically based on nitrogen requirements for crops;  
12 right? 11:39AM

13 A Correct.

14 Q That was at least true back in -- whenever you  
15 published this. Then there's a sentence a little  
16 bit farther down that says, in these situations soil  
17 P concentrations can increase rapidly, and it cites  
18 something that you wrote and something that Dr.  
19 Sharpley wrote; right? 11:40AM

20 A Okay, yes. 11:40AM

21 Q And that's a true statement; right?

22 A Yes.

23 Q Okay. Read the next sentence for me, if you  
24 would, please.

25 A As soil P levels increase, the soluble P 11:40AM  
94

1 concentration in runoff water typically increases.

2 Q And it's referenced a bunch of people?

3 A Right.

4 Q And that's true as well; right?

5 A Yes. 11:40AM

6 Q Well, I've got a quote here I can't find.

7 MR. McDANIEL: Damed.

8 MR. NANCE: We'll find it.

9 Q Well, let me just ask you if this statement is  
10 true, that -- yeah, okay. Second complete paragraph  
11 just below midpoint of the page, unfortunately under  
12 agronomic production systems where grains are  
13 harvested, McCollum's findings indicate that many  
14 years and perhaps even decades will be required to  
15 effectively reduce soils that have excessive P 11:41AM  
16 concentrations to levels where manure can once again  
17 be used as a crop nutrient source. Did I read that  
18 correctly?

19 A Yes, I believe you did.

20 Q Okay. Would that be true, as well, for soils  
21 where forages are grown? 11:42AM

22 A Generally, yes, there's going to be some  
23 variability like I mentioned before.

24 Q Okay, but whether it goes down as fast as it  
25 comes up, it still takes a long time to go down? 11:42AM  
95

A Correct.

Q Okay. Next sentence, this limitation, and I  
believe that's on P-based soils or P-based systems.  
This limitation creates an economic hardship for  
farmers who will be faced with purchasing chemical  
fertilizers to supply crops nitrogen and potassium  
requirements previously obtained with manure. What  
do you mean by that sentence, sir? 11:42AM

A Well, if a farmer can no longer use litter or  
manure because it is deemed as a risk, the P level  
is too high, is deemed -- whatever the regulations  
they're working under, they can't apply litter  
there, then he is going to have to purchase nitrogen  
or potentially potassium fertilizer, which he  
wouldn't have had to purchase in the past before  
that regulation limited his ability to apply litter. 11:43AM

Q The first sentence of the next paragraph says,  
few practical options for reducing high soil P  
concentrations are available. What are the options  
that are available for reducing high P soils? 11:43AM

A Basically the only practical option is to grow  
crops that remove it from the soil, and that takes a  
long time.

Q Okay. On the next page, which is Page 119 in  
the report, there's that small paragraph at the 11:44AM  
96

bottom. Let me look at the sentence immediately  
above that. Forage crops that may be produced on  
sites that are P enriched -- are you with me? I'm  
sorry.

A Yes. 11:44AM

Q Would only be considered a successful P  
remediation practice if the manure from the  
livestock fed these crops and was used only on  
fields that are not P enriched. What does that  
sentence mean, sir? 11:45AM

A Let me read it again.

Q Please do. Whatever you need to do.

A I think it's a summary statement saying that  
if you are growing forage crops to actively  
remediate the phosphorus, reduce phosphorus  
aggressively and -- I can't find the word -- on  
purpose, trying to pull the phosphorus soil levels  
down and you are feeding that forage to animals,  
then the manure from those animals would be -- it  
would be best served if your goal is to pull the  
phosphorus level as fast as you can. The manure  
from those animals should not be redeposited on the  
same soil. 11:45AM

Q You're better off if you can remove the manure  
to some other location? 11:46AM

1 A Correct.  
2 **Q Okay. Let me ask you just kind of a side**  
3 **question to that. If cattle are grazing on a**  
4 **pasture that hasn't been fertilized with either**  
5 **commercial fertilizer or poultry litter -- 11:46AM**  
6 A Uh-huh.  
7 **Q -- does the waste the cattle deposits on the**  
8 **field enrich the soil in phosphorus?**  
9 A It really depends on your scope of reference.  
10 **Q Okay. 11:46AM**  
11 A If there's no phosphorus entering the system,  
12 there's no phosphorus being applied, then it's more  
13 of a recycling, okay, but what they can tend to do  
14 is the forage crops take up phosphorus from within  
15 that rooting zone of the soil from what shallow 11:46AM  
16 depth or deep depth, wherever the roots are, and  
17 then put it into the tissue of the forage plants.  
18 The cattle eat it, and then what they defecate on  
19 the soil will relocate some of that phosphorus from  
20 within the roots of the soil onto the soil surface. 11:47AM  
21 **Q Would it be fair to say that it moves**  
22 **phosphorus around but doesn't add any phosphorus to**  
23 **the soil?**  
24 A If there's no phosphorus coming from the  
25 outside of that field -- 11:47AM

98

1 **Q Correct.**  
2 A -- into that field, then it's just recycling  
3 within the field.  
4 **Q Okay. Now, in the Illinois River watershed,**  
5 **to what extent is cattle manure removed from 11:47AM**  
6 **enriched phosphorus fields and used somewhere else?**  
7 A Again, based on a very cursory overview,  
8 understanding that detailed information, I don't  
9 believe much cattle manure is redistributed across  
10 the watershed at different locations from where it's 11:48AM  
11 deposited.  
12 **Q So would it be fair to say, in your**  
13 **understanding, most of it stays where it falls,**  
14 **subject to whatever transport happens after that,**  
15 **natural transport, not manmade transport? 11:48AM**  
16 A That's my understanding.  
17 **Q Okay. Let's turn over to Page 121, Dr. Coale.**  
18 **This Table 2 at the top of the page --**  
19 A Yes, sir.  
20 **Q -- has something to do with soil phosphorus 11:48AM**  
21 **concentrations. I just need you to help me**  
22 **understand this table a little better.**  
23 A Okay. I'll do my best. It's been a while  
24 since I've seen it.  
25 MR. McDANIEL: Was that the question or is 11:49AM

99

one coming?  
**Q What does this table show?**  
A Oh. I didn't know you were waiting for me.  
**Q I'm sorry.**  
A Okay. Well, if you look down the first 11:49AM  
left-hand column, those are four different physical  
locations, four different farms. The second column  
from the left, there's -- each farm there's a forage  
system and grain production system in place at each  
farm, and those are defined more fully in the 11:49AM  
footnotes, and then if you look at the major  
horizontal heading across the top of the table --  
**Q Uh-huh.**  
A -- that was the rate that the manure was  
applied to this site at the rate based at the rate 11:50AM  
in units of kilograms P per hectare over years,  
total load over four years that was applied. So the  
application to the site was either zero, 400  
kilograms P per hectare over four years, 800, 1,200,  
1,600. 11:50AM  
**Q Okay. How big a unit of land is a hectare?**  
A Roughly two and a half acres.  
**Q Okay. Then what do you have below that, sir?**  
A That's the soil P concentration as in Mehlich  
III P in milligrams per kilograms, parts per 11:50AM  
100

million.  
**Q Okay, and I think we discussed this at the**  
**hearing but I'm a pounds per acre guy. So what's**  
**the rule of thumb that would convert this unit to**  
**pounds per acre? 11:50AM**  
A Well, in Oklahoma it's times two.  
**Q Okay. So you would have had, at least in some**  
**of these STPs, up as high as, oh, I see 403 in the**  
**far right-hand column. That would be 403 milligrams**  
**per kilogram? 11:51AM**  
A Right.  
**Q And in Oklahoma that would be approximately**  
**800 pounds per acre?**  
A Correct.  
**Q Okay. On Page 122, Dr. Coale, just below -- 11:51AM**  
**in the results and discussion portion, the first**  
**sentence there says, the forage crop system**  
**consistently removed more P from the harvested**  
**forage crops than was removed by the harvested**  
**grains for the grain system across the five soil P 11:52AM**  
**treatment at all locations.**  
A Correct.  
**Q Does that mean that for phytoremediation,**  
**forages -- at least this study says forages are**  
**better than grains? 11:52AM**

101



1	A Correct.		some instances with grain, the STP was higher?	
2	Q Okay. In this study, did you remove the		A Yes.	
3	forage or the hay from the site and take it		Q And forage systems, it was lower, 7 to 15	
4	somewhere else after each crop?		percent?	
5	A Yes.	11:52AM	A That's what it says, yes.	11:56AM
6	Q To what extent is that done in the pastures of		Q And bottom sentence in that paragraph, the	
7	the Illinois River watershed?		year-to-year variation indicated that three years of	
8	A Well, unless the pastureland is harvested for		elevation are not enough -- evaluation, excuse me,	
9	hay and the hay is baled and taken off site, the		are not enough time to make any definitive	
10	other scenario is it's just ingested by the cattle	11:52AM	prediction about how much it will take to remediate	11:56AM
11	and stays on the site.		P-enriched soils with either cropping system?	
12	Q And it's recycled basically?		A Correct.	
13	A Well, it goes into the mass of the animal and		Q So based on this study you did, it's going to	
14	recycled on the site, whatever is not retained by		be at least more than three years?	
15	the animal in its growth.	11:53AM	A Correct.	11:56AM
16	Q Okay. Do you know yourself what portion of		Q Okay. You averaged these results over four	
17	the pastures in the Illinois River watershed with		locations. Was that statistically appropriate?	
18	elevated STPs have hay removed from the site?		A I'm sure it was or we wouldn't have done it.	
19	A No, I don't.		Q That's a good answer. You wouldn't do	
20	Q Okay. Do you know if anyone for the defense	11:53AM	anything inappropriate, would you?	11:56AM
21	knows that?		A Not knowingly.	
22	A Not that I'm aware of.		Q But use of an average, is that sometimes an	
23	Q Let's go over to Page 126, sir. At the fourth		appropriate statistical tool?	
24	complete paragraph, just about midway down, you		A Absolutely, absolutely.	
25	found that no significant reductions in soil P	11:53AM	Q Okay. On Page 128, sir, in conclusions and	11:57AM
	102		104	
1	concentrations were observed for the majority, 33		perspectives at the bottom, I guess it's the third	
2	out of 40, of the soil P concentration comparisons		sentence down there, fourth row down, line down,	
3	for the period 2001-2004 across the five manure		however, during the first three years of the study,	
4	treatments and four locations for the two cropping		changes in soil P concentration have not reflected	
5	systems. Did I read that correctly?	11:54AM	the ability of forage production systems to	11:57AM
6	A Yes, you did.		accumulate and remove P from P-enriched fields. Did	
7	Q What's that mean?		I read that correctly?	
8	A That for most of the sites, 33 out of 40,		A Yes, you did.	
9	where we had a comparison, that even though we grew		Q What's that mean?	
10	crops -- crops and removed them from the system,	11:54AM	A That even though these forage systems are	11:58AM
11	that the soil phosphorus levels didn't decrease.		accumulating phosphorus in the soil and that	
12	Q Okay. On Page 127 in that first paragraph,		accumulated phosphorus in the tissue, it's being	
13	sir, you're talking about year-to-year variances		removed from the field. You don't see that	
14	here.		reflected in a decline in soil P levels. The soil	
15	A Okay.	11:55AM	has the ability to maintain that elevated level even	11:58AM
16	Q The second sentence, during the three-year		though you've taken the phosphorus out of the	
17	period, 2001 to '04, the soil P concentration in the		system.	
18	zero treatment level averaged over the four		Q The next sentence says, there have been no	
19	locations ranged from 12 percent less to 11 percent		consistent reductions in soil test P concentration	
20	greater than the 2001 or 2002 for one site baseline	11:55AM	using a forage crop system. So I guess that says	11:58AM
21	value for the grain system, and from 7 to 15 percent		the same thing another way?	
22	less than the 2001 baseline value for the forage		A Correct.	
23	system.		Q Okay. Last two sentences in that paragraph on	
24	A Uh-huh.		Page 128, however, it will probably take many years	
25	Q Am I reading that correctly to mean that in	11:55AM	or decades to reduce the P concentrations to levels	11:58AM
	103		105	

1 considered optimum. This finding is in concurrence  
 2 with McCollum 1991.  
 3 A Uh-huh.  
 4 Q Let's compare the time it takes to elevate the  
 5 STP with the time it takes to reduce it if you are 11:59AM  
 6 using litter applications.  
 7 A Okay.  
 8 Q Does it take as long in terms of time to go up  
 9 as this indicates it may take to come down?  
 10 A No. Generally the STP levels can be elevated 11:59AM  
 11 much more quickly than they come down.  
 12 Q Okay.  
 13 MR. NANCE: It would be a good place for a  
 14 lunch break.  
 15 MR. McDANIEL: It's your call. 11:59AM  
 16 MR. NANCE: Let's break until 1:00.  
 17 MR. McDANIEL: That's fine.  
 18 VIDEOGRAPHER: We're now off the Record.  
 19 The time is 12:00 p.m.  
 20 (Following a lunch recess at 12:00 p.m. 11:59AM  
 21 proceedings continued on the Record at 1:08 p.m.)  
 22 VIDEOGRAPHER: We are back on the Record.  
 23 The time is 1:08 p.m.  
 24 Q Good afternoon, Dr. Coale. I think before we  
 25 broke, we were talking about phytoremediation and 01:07PM  
 106

1 reduction of high P soil.  
 2 A Right.  
 3 Q I'm going to skip, and you're going to not  
 4 object, I think the McCollum article because I found  
 5 it very hard to read. 01:07PM  
 6 A Okay.  
 7 Q So let's go to the Read article.  
 8 A Are we finished with this?  
 9 Q Yes, at least for the time being. Let me show  
 10 you what I've marked as Coale Exhibit No. 4 and see 01:07PM  
 11 if that is the Read article you referred to in your  
 12 expert report.  
 13 A Yes, I think it is. I realized over lunch  
 14 time you asked me a question about a specific  
 15 phytoremediation-type article specific to the IRW. 01:08PM  
 16 Q Okay.  
 17 A There was one University of Arkansas  
 18 publication, like Coblenz, that referred to removal  
 19 with pasture grasses in the IRW.  
 20 Q Okay. Spell the author's name as best you 01:08PM  
 21 can.  
 22 A C-O-B-L-E-N-T-Z, approximately.  
 23 Q Is that -- I don't recall that being in  
 24 your --  
 25 A I think it was in Dr. Johnson's materials. 01:08PM  
 107

Q Okay.  
 MR. McDANIEL: It was actually an exhibit  
 to his deposition.  
 Q What can you tell me about that article just  
 from your recollection, since I don't have a copy, 01:08PM  
 the Coblenz article?  
 A Been quite some time since I looked at it, but  
 basically looked at producing forage grasses, I  
 think Bermuda grass and fescue, and looked at soil  
 test phosphorus levels and the rate of soil test P 01:09PM  
 decline over a number of years with continued  
 harvest of hay, and the different scenarios had  
 different rates of decline.  
 Q Was there anything unusual about the  
 conclusions of that article that's not, in general 01:09PM  
 terms, consistent with the ones you cited?  
 A No. They just had different situations, had  
 different decline rates they predicted, and nothing  
 unusual about it.  
 Q Okay. Tell me just in general terms what was 01:09PM  
 done in this Read article, which is Exhibit No. 4.  
 A This is where they looked at the -- again, it  
 was another -- they built up soil phosphorus levels  
 using broiler litter and they looked at the decline  
 in STP levels over time depending on the 01:10PM  
 108

pretreatment of the land. I think it was different  
 loading rates of phosphorus through litter for  
 several years, and STP declined with time with  
 continued production, continued hay production off  
 those sites. 01:10PM  
 Q Okay. Let's look at the first page of that,  
 which is numbered 1492.  
 A Uh-huh.  
 Q The upper right-hand column, let me read a  
 sentence and let's talk about it for a moment. 01:10PM  
 Because the N-P ratio of litter is much lower than  
 the ratio N and P absorbed from the soil by Bermuda  
 grass, parenthesis, two to one versus ten to one,  
 Evers 2002 --  
 A Uh-huh.  
 Q -- soil P levels in many broiler farms are  
 substantially greater than those required for  
 optimum forage yield. Is that the situation that  
 we've discussed before; is it considered a true and  
 accurate statement by you? 01:11PM  
 A Yes.  
 Q Okay. Let's look same page the first full  
 paragraph of the right-hand column. I'll read again  
 another sentence and let's talk about it.  
 Harvesting high biomass forage crops and utilizing 01:11PM  
 109

1 them at a site remote to the source is an important  
2 component of soil P remediation, despite the fact  
3 that P levels may be reduced slowly or remain  
4 unchanged, especially with continued manure  
5 application, and it cites Pant 2004. Is that 01:11PM  
6 consistent with what you all found about the need to  
7 remove the hay from the site?

8 A If you remove the hay from the site, then you  
9 would expect the rate of remediation, the rate of  
10 soil test phosphorus to climb and be faster. 01:12PM

11 Q Okay. When we say remediation, is that  
12 another word for remedy?

13 A I think remedy is probably the root of the  
14 word.

15 Q Okay. Does the -- if you're trying to remedy 01:12PM  
16 the situation, would you keep putting more litter on  
17 the field you're trying to remedy?

18 MR. McDANIEL: Object to the form.

19 A If your goal is to reduce soil P levels as  
20 dramatically as possible, then you would not want to 01:12PM  
21 be adding P to the system.

22 Q Okay. Then several lines down below there it  
23 says I think something that we've heard before.  
24 It's widely accepted that remediation of excess soil  
25 P by crop removal is slow. 01:13PM

110

there's a higher concentration at the surface and as  
you go deeper, there's probably a lower  
concentration of phosphorus.

Q What is P sorption?

A P sorption is how phosphorus held onto soil 01:15PM  
particles.

Q Okay. The next sentence says, increased P  
concentration in surface soil increases the  
potential for P transport by runoff or leaching that  
may cause eutrophication. Why is that the case? 01:15PM  
Well, is that the case first?

A Well, that sentence assumes that that runoff  
or leaching is reaching a water body; it's connected  
to a water body where eutrophication can happen.

Q Is that a reasonable assumption? 01:15PM

A Sometimes it happens; sometimes it doesn't,  
yes.

Q And then what -- is this emphasizing the  
surface of the soil because that's where the  
phosphorus land and that's where the rain lands; 01:15PM  
they both hit the surface?

A Correct.

Q Okay. Down in the last paragraph, sir, the  
last paragraph in that left-hand column about  
halfway down, it talks about options to remediate. 01:16PM

112

1 A I got it.

2 Q Same paragraph. That's certainly a true  
3 statement based on what we've talked about before?

4 A Right. They referenced this same McCollum  
5 article I referenced I believe. 01:13PM

6 Q Okay. Let's turn the page and look at the  
7 upper left-hand column of Page 1493. I'll read the  
8 first sentence and then let's talk about it. A  
9 complicating factor with broiler litter is that  
10 applying it to soil without incorporation can 01:13PM  
11 accumulate P and lower P sorption at the soil  
12 surface compared with deeper soil layers, and it has  
13 a couple of references. What does that mean?

14 A Let me reread it, please.

15 Q Please. 01:14PM

16 A Okay. The first part of it, accumulating P at  
17 the soil surface, is logical. If you're not tilling  
18 it in or doing anything to incorporate it into the  
19 soils, you are increasing the phosphorus  
20 concentration right at the surface of the soil. 01:14PM  
21 That makes sense. And the second part says lower P  
22 sorption at the soil surface compared with  
23 the deeper soil layers, which just means that your  
24 continued practice like that, you develop -- a  
25 stratification of phosphorus with depth means 01:14PM

111

It's right after the Cox cite.

A Uh-huh.

Q Let me read those one at a time and we'll talk  
about them because they've got a couple.

A Okay.

Q Producer options to remediate soils that test  
high in P include, one, substituting fertilizer N  
additions for broiler litter N to enhance plant  
growth and uptake of N and P.

A Okay. 01:16PM

Q We've talked around that, but could you  
explain to me what that means?

A Well, basically if you are trying to reduce  
soil phosphorus levels through phytoremediation as  
rapidly and dramatically as possible, that 01:16PM  
phytoremediating plants, in this case, the forage  
grass species, needs to be growing robustly, so it's  
going to need nitrogen additions so it can grow  
robustly and extract the maximum amount of  
phosphorus from the soil, and what they're saying is 01:17PM  
that those nitrogen additions probably shouldn't be  
from a manure source but should be from a phosphorus  
-- I mean, nitrogen fertilizer source.

Q Okay. In that context, would it be  
self-defeating to put on more litter that contained 01:17PM

113

1 phosphorus, self-defeating to your goal of  
2 remediating as quickly as you can?  
3 A Yes. If your goal is to bring the soil P  
4 levels down as quickly as possible, you don't want  
5 to add phosphorus to it. 01:17PM

6 **Q Then the second option is, two, cessation of**  
7 **litter application and continued harvest and removal**  
8 **of forage biomass until soil test P returns to a**  
9 **more acceptable level.**

10 A Uh-huh. 01:17PM

11 **Q Does that mean just simply stop putting more**  
12 **on, more litter on?**

13 A Yes. That's just what we mentioned before.

14 **Q Okay. Down at the very bottom of that column,**  
15 **sir, still on Page 1493, it says -- talks about some 01:18PM**  
16 **studies, but says their results of significant**  
17 **correlation between the concentration of soluble**  
18 **reactive P in runoff and M3P in soil samples, zero**  
19 **to fifteen-centimeter depth, suggest knowledge of**  
20 **soil test P can be used to assess P runoff in 01:18PM**  
21 **pasture before manure is applied and thereby help a**  
22 **grower be proactive about when to resume**  
23 **applications of broiler litter. Is that a true**  
24 **statement in your judgment?**

25 A Let me go back over it again, please. 01:18PM  
114

1 **Q Sure.**

2 A At the work under the assumption, I'm not  
3 picking up real quickly, but that sentence starts  
4 out but the results of significant correlation. I  
5 don't -- assuming they're referencing a previously 01:19PM  
6 cited study, which I presume they are, that showed a  
7 correlation, a positive correlation between soluble  
8 reactive P and soil test P or Mehlich III P, then  
9 that would be a true statement, if they're  
10 referencing that data of someone else. 01:19PM

11 **Q As a general matter, is there a positive**  
12 **correlation between soluble reactive P and M --**  
13 **Mehlich III P?**

14 A Yes, generally.

15 **Q Okay. Now, it says before manure is applied. 01:19PM**  
16 **Why is that significant in this context?**

17 A There have been -- and, again, I'm trying to  
18 piece together where they're referencing within  
19 right in here.

20 MR. McDANIEL: If you need to take time to 01:19PM  
21 read, you take whatever time you need with that  
22 document --

23 A Okay.

24 MR. McDANIEL: -- to be satisfied with your  
25 answer. 01:19PM

115

A Okay.

MR. McDANIEL: I just don't want you to be  
rushed.

A All right. Let me -- I'm having trouble  
figuring who they, the reference there refers to. 01:20PM

MR. ELROD: Take seven hours if you want.

A It may take that long to read it.

**Q That would be a bit generous.**

A Okay. I believe the understanding -- it says  
before manure is applied, meaning they can use that 01:20PM  
information as part of the planting process.

**Q Would it be fair to say knowing your Mehlich**  
**III STP will help you know whether or not as a -- to**  
**be proactive before resuming applications, that you**  
**know when it's good to apply it again, apply litter 01:21PM**  
**again?**

A Well, I would suggest that the Mehlich III P  
soil test value is an important component of an  
assessment, and that assessment may have many other  
components like the P index does, but that's one of 01:21PM  
the components that we use to assess when you should  
apply litter and when you shouldn't.

**Q Okay. The next sentence, Dr. Coale, says**  
**several studies show soil test P is associated**  
**positively with P losses in runoff water and would, 01:21PM**  
116

**therefore, be useful in risk assessment with**  
**references. Is that a correct sentence?**

A Well, that sentence referenced a published  
piece of work, Sharpley 1995, so I'm assuming they  
got that right out of there, but in general, if 01:22PM  
we're talking about a correlation between two  
datasets, that there have been datasets published  
where the soil test P is positively correlated with  
P loss in runoff.

**Q Let's go back to your report, which is Exhibit 01:22PM**  
**No. 1. You should still have it there. I'm looking**  
**on Page 7, Dr. Coale.**

A Can I put this aside?

**Q Yes. You need to keep it there for the**  
**reporter. She'll want it at the end of the day. 01:22PM**

A I'm trying to keep my piles straight. Where  
are we looking again, sir?

**Q That top subparagraph, which is C from the**  
**previous page.**

A On Page 6? 01:23PM

**Q No. It's top of Page 7. It carries over to**  
**Page 7.**

A Okay.

**Q You say there after citing all of these**  
**articles? 01:23PM**

117

1	A Uh-huh.		steep. If you look at the data in that Reed paper	
2	<b>Q The kinetics of P soil -- excuse me, of soil P</b>		we just talked about, it can be very steep to flat.	
3	<b>mineralization and dissolution, combined with the</b>		So that means the rate is going to be very site	
4	<b>rate of P removal by crop harvest, will control the</b>		specific, very soil specific, very specific -- be	
5	<b>rate of STP decline over time.</b>	01:23PM	determined by how that land was treated in the past	01:26PM
6	A Uh-huh.		and how those different pools of phosphorus are	
7	<b>Q What do you mean by that sentence, sir?</b>		exchanging with themselves in the soil. So it's	
8	A That when you have a pool of phosphorus in the		assuming you have a constant linear rate of twelve	
9	soil, that pool was divided up between phosphorus		pounds per acre declining over time. I think it's	
10	which is physically and chemically adsorbed or	01:23PM	just not a reliable number.	01:26PM
11	attached to the solid phases of the soil. As		<b>Q Have you developed any opinion on how long it</b>	
12	phosphorus is tied up in organic matter in the soil,		<b>will take to bring down the high P soil, the high P</b>	
13	some of that organic matter is -- turns over, is		<b>level in these soils in the Illinois River watershed</b>	
14	very dynamic. It degrades quickly and releases		<b>by phytoremediation?</b>	
15	soluble P, and some of it is very resistant, and	01:24PM	MR. McDANIEL: Object to the form.	01:26PM
16	there's also phosphorus which is dissolved in the		A No.	
17	soil and water. So it's the rate of those		<b>Q Do you know if anyone for the defendants has</b>	
18	transformations within those different pools of		<b>done that?</b>	
19	phosphorus in the soil that one regulates the supply		A Not that I'm aware.	
20	of phosphorus through the soil for uptake by these	01:24PM	<b>Q Okay. In the next little subparagraph that's</b>	01:26PM
21	remediating plants, and that will supply that. It		<b>unlettered there, you say that the model derived by</b>	
22	also regulates how much phosphorus you will pick up		<b>Dr. Johnson appears to be a pure academic exercise.</b>	
23	or will show up in the soil test P evaluation of the		<b>Are you with me there?</b>	
24	soil.		A Yes.	
25	<b>Q Is what you've just told me a general</b>	01:24PM	<b>Q What do you mean when you say that it was --</b>	01:27PM
	118		120	
1	<b>description of the way phosphorus works in the soil</b>		<b>let's take these phrases one at a time. It wasn't</b>	
2	<b>and with plants?</b>		<b>developed from physical data?</b>	
3	A Correct.		A Uh-huh.	
4	<b>Q Okay. Your next sentence says, thus, since</b>		<b>Q What do you mean by that?</b>	
5	<b>the rate of STP declined when no additional P is</b>	01:24PM	A Is that he applied the assumption that soil	01:27PM
6	<b>added to the soil while crop harvest continues is</b>		test phosphorus levels declined at the same rate as	
7	<b>unknown --</b>		they are increased, that twelve pounds per acre loss	
8	A Uh-huh.		rate. Didn't seem -- at least from his	
9	<b>Q -- the hypothetical model of STP decline over</b>		presentation, I saw no data that supported where	
10	<b>time that was developed by Dr. Johnson, and it cites</b>	01:25PM	that twelve pound per acre rate came from.	01:27PM
11	<b>his report, is not quantitatively defensible and has</b>		<b>Q Are you saying that he didn't have data for</b>	
12	<b>no apparent application. Why do you say the rate of</b>		<b>his beginning point based on the STPs in the</b>	
13	<b>decline is unknown?</b>		<b>watershed?</b>	
14	A Well, my understanding of the soil test P		A No. What he -- the premise of that model was	
15	decline model that he presented in his report	01:25PM	the rate of decline.	01:28PM
16	assumed the rate of decline was equal to the rate of		<b>Q Okay.</b>	
17	elevation of soil test P with added fertilizer,		A And I think he imposed a constant rate of	
18	which was twelve roughly, I think ten to fifteen, I		decline that I couldn't determine where he got that	
19	think an average of 12 pounds per acre per year, and		from, other than that single assumption.	
20	he used that as a constant linear decline rate, and	01:25PM	<b>Q Okay. The next thing you say, it was not</b>	01:28PM
21	I was -- my whole point was, and I gave a couple of		<b>validated by independent datasets. What do you mean</b>	
22	these references here, to show that that rate of		<b>by that?</b>	
23	decline can be all over the board. It can be almost		A Well, bear in mind, I'm not a modeler and	
24	zero or practically nonexistent for that one		modeling is not what I do, but typically when you	
25	Kratochvil paper we referenced, and it can be very	01:25PM	use models and try to understand where they fit in,	01:28PM
	119		121	

1 you usually take a dataset and develop your model  
 2 and your parameters. For like this case we're  
 3 talking about now, you would take a dataset and from  
 4 that dataset, you would develop that rate of  
 5 decline, which Johnson assumed was twelve. So you 01:28PM  
 6 take that dataset to develop your model, and then  
 7 you would go out and collect another dataset to see  
 8 whether the model you developed actually predicted  
 9 what you saw in real world, and if your model that  
 10 you came up with using a separate dataset accurately 01:29PM  
 11 predicted an independent dataset, then you can say  
 12 that your model is validated, and I didn't see where  
 13 that took place.

14 **Q Then what do you mean when you say it has no**  
 15 **predicted capacity?** 01:29PM

16 A Well, if you develop a model and the  
 17 assumptions in the model back to that twelve linear  
 18 coefficient of decline, if you develop a model based  
 19 on a dataset and you can't demonstrate that that  
 20 model predicts an independent dataset, then that 01:29PM  
 21 model can't be used to predict -- have predictive  
 22 capacity. In other words, it has -- you can't use  
 23 it to speculate what might happen in a hypothetical  
 24 situation.

25 **Q Okay.** 01:29PM

1 2 2

**Illinois River watershed that has elevated  
 phosphorus is without an active pathway to water?**

MR. McDANIEL: Object to the form.

A No, I don't.

**Q Do you know if anyone from the defendants is** 01:32PM  
**prepared to speak to that?**

A I don't know that.

**Q Okay. What would a piece of land without an  
 active pathway be? Just give me an example.**

A If you had a field that -- this is a crystal 01:32PM  
 clear example. If you had a field that had a  
 concave basin so water could potentially drain off  
 that field over the surface and reach a point where  
 it would actually accumulate or be retained and  
 wouldn't, if you would, make it over the next hump 01:32PM  
 and down the hill, that would be not an active  
 pathway.

**Q Are there any other kinds of situations that**  
**we might find in the Illinois River watershed that**  
**don't have an active pathway?** 01:33PM

A Sure. You can have runoff water as generated  
 from one field, which may, in surface flow, exit  
 that field and go into an adjacent field, which at  
 that point it may run across a different set of  
 physical conditions in the soil, where you may have 01:33PM

1 2 4

1 MR. NANCE: Let's go ahead and take a quick  
 2 break just to change the tape.

3 VIDEOGRAPHER: We're off the Record. The  
 4 time is 1:31 p.m.

5 (Whereupon, a discussion was held off 01:30PM  
 6 the Record.)

7 VIDEOGRAPHER: We are back on the Record.  
 8 The time is 1:31 p.m.

9 **Q Dr. Coale, in Subparagraph E on Page 7 --**

10 A Yes, sir. 01:30PM

11 **Q -- you say, second sentence, in order for P**  
 12 **losses from an agricultural field to be of**  
 13 **heightened ecological concern, the site must contain**  
 14 **both a substantial source of P and active pathways**  
 15 **through which the P can be transported to an** 01:31PM  
 16 **adjacent body of water. Can you tell me what you**  
 17 **mean when you say an active pathway?**

18 A That there has to be a mechanism, which is  
 19 usually water, to move phosphorus from the source to  
 20 a body of water. That pathway, whether it's surface 01:31PM  
 21 overland flow or what have you, you have to have --  
 22 an active pathway has to be open and continuous and  
 23 connected to that body of water so that it actually  
 24 has an impact on that body of water.

25 **Q Sir, do you know how much of the land in the** 01:31PM

1 2 3

infiltration in the soil, and the runoff path may be  
 attenuated at that point, or you may have runoff  
 from a field that reaches the edge of field, and if  
 the edge of the field is a wood lot, it may go into  
 that area and then disperse and infiltrate into the 01:33PM  
 soil.

**Q Did you say a wood lot?**

A Yeah, a wooded area.

**Q Okay.**

A Sorry. A wooded area. 01:33PM

**Q Okay.**

A So, yes, it did run off the field, and maybe  
 it ran into a wooded area, and in that situation  
 surface soil conditions change, et cetera. It may  
 infiltrate and no longer be runoff. So there's 01:33PM  
 different scenarios where you may have runoff water  
 generated on a field but it's not connected to a  
 water body.

**Q If there's runoff water from a field and it's**  
**carrying with it some dissolved phosphorus --** 01:34PM

A Yes.

**Q -- what happens to the phosphorus if that**  
**water sinks into the ground before it gets to a**  
**stream?**

A Well, it will go with the water. Okay. The 01:34PM

1 2 5



1 water will go into the soil, infiltrate in the soil,  
 2 and once water is moving through a soil, that  
 3 phosphorus that is dissolved in that water  
 4 oftentimes adsorbs chemically onto clays, adsorbed  
 5 into organic water, or if the soil happens to be 01:34PM  
 6 very shallow and reaches a place where it's an  
 7 outlet site, it may seep back out and continue on  
 8 its way, so it may be many different fates. It  
 9 really depends on the site and the soil conditions  
 10 that are going on at that particular site. 01:35PM

11 **Q If it -- if the soil is shallow and it gets**  
 12 **into somewhere and leaks back out, is that something**  
 13 **that happens in the Karst geology in the Illinois**  
 14 **River watershed?**

15 A From my understanding of Karst, yes, it can. 01:35PM

16 **Q Am I understanding correctly that if that**  
 17 **phosphorus moves from a higher field to the next**  
 18 **lower field and sinks in, that the dissolved**  
 19 **phosphorus just acts like phosphorus there and goes**  
 20 **through the same chemical processes that you've 01:35PM**  
 21 **described?**

22 A If it's dissolved in the soil water and it  
 23 infiltrates in the soil of a different field, then,  
 24 yes, it's prone to be accumulated onto the solid  
 25 phases of the soil by adsorption. It can be fixed 01:35PM

126

1 by iron, aluminum or calcium if you know the pH. It  
 2 can be incorporated into organic matter. So there's  
 3 a lot of different fates.

4 **Q Is that the same process basically that**  
 5 **happens when you apply litter on, say, the first 01:36PM**  
 6 **field?**

7 A Yes, same process.

8 **Q The same sort of thing happens?**

9 A Same processes.

10 **Q Okay. What happens when it rains again? 01:36PM**

11 A On that second field, the lower field?

12 **Q On the second field.**

13 A Well, it really depends. It would depend --

14 **Q If there's runoff water.**

15 A If there's runoff water generated, then it 01:36PM  
 16 really depends. If there's enough -- what load, if  
 17 you will, of soluble P is in the soil water, whether  
 18 that moved with the water or not, and what  
 19 concentration depends on how much soil water --  
 20 soluble soil P there is at that site at that time. 01:36PM

21 **Q Well, does it -- some of it go into solution**  
 22 **and move to the third field down?**

23 A Some will.

24 **Q Okay, and eventually to a stream or a river?**

25 A It can or could not. Depends on the site. 01:36PM

127

**Q If there's uninterrupted flow from the top**  
**field to the water?**

A It may make it there or it may not.

**Q Okay. If Field No. 1 is a high P field where**  
**litter has been applied and Field No. 2 is not, does 01:37PM**  
**that dissolved phosphorus that moves from Field 1 to**  
**Field 2 in some way increase the STP of Field 2?**

A It may.

**Q Okay. Through the same mechanisms that you've**  
**talked about? 01:37PM**

A Right.

**Q Is there anything other than a physical**  
**barrier -- if there's an uninterrupted slope from**  
**Field 1 to the water --**

A Uh-huh. 01:38PM

**Q -- is there anything other than a physical**  
**barrier that will stop the long-term movement of**  
**that phosphorus from Field 1 to the water?**

MR. McDANIEL: Object to the form.

A Well, given that scenario you outlined, there 01:38PM  
 could be chemical barriers. The soil could be  
 amended or I suspect if there's a radical difference  
 in the soil type, it could be a naturally occurring  
 chemical where soluble P was generated at the higher  
 elevations of Field 1 or Field 2. As it moved on 01:38PM

128

way down the slope, it encountered either a  
 purposefully constructed chemical barrier, in other  
 words, you added something to the soil to trap  
 phosphorus or a radically different soil type change  
 where there was a high phosphorus adsorption 01:38PM  
 capacity of that soil down, further down the slope.  
 Then as that soluble phosphorus made its way down  
 the slope and it hit that chemical barrier, it could  
 be adsorbed into the soil and then no longer  
 available for continuing to move down the slope with 01:38PM  
 the drainage water.

**Q What sort of chemical would -- might**  
**deliberately be put in that pathway to stop the**  
**phosphorus?**

A Well, we've played around with some of them, 01:39PM  
 and it's iron compounds, calcium compounds, aluminum  
 compounds. Depends on the pH of the soil and what  
 you are trying to accomplish, but there's ways to do  
 it.

**Q Okay. What naturally occurring soil, 01:39PM**  
**different soil type might have the same effect?**

A Well, if you -- it's -- if you had a radical  
 shift in pH in the soil, for example, or you had a  
 radically increasing clay content of the soil and  
 that runoff water became in contact with it, it 01:39PM

129

1 could absorb the phosphorus out of the soil.  
2 **Q To what extent in the Illinois River watershed**  
3 **are there radical differences in pH or clay content**  
4 **like you've described?**  
5 A That I don't know. 01:39PM  
6 **Q Does anyone who will testify for the**  
7 **defendants to your knowledge know about such radical**  
8 **changes in soil pH or clay?**  
9 A I don't know. I haven't discussed that with  
10 anybody. I don't know. 01:40PM  
11 **Q Okay. Is there anything besides a deliberate**  
12 **amendment of the soil like you've described or the**  
13 **kind of different soil compositions like you've**  
14 **described that -- and a physical barrier --**  
15 A Right. 01:40PM  
16 **Q -- that would stop the progress of phosphorus**  
17 **from the high Field 1 to the stream?**  
18 MR. McDANIEL: Object to the form.  
19 A Well, of course, if you had a change in  
20 topography so you no longer had a gravity gradient, 01:40PM  
21 it would stop it. It would accumulate at whatever  
22 the low spot was.  
23 **Q Okay, and I'm assuming an uninterrupted. I**  
24 **realize if there's a dam or something or a hole?**  
25 A Or something uphill. 01:40PM

130

1 **Q Right.**  
2 A Okay.  
3 **Q Can you think of anything other than the**  
4 **things we've talked about so far?**  
5 A For blocking soluble P, no, sir. 01:41PM  
6 **Q Okay. What about particulate P?**  
7 A That's why I asked that question. Particulate  
8 P, yes, there are physical barriers in the form of  
9 vegetation.  
10 **Q Okay. 01:41PM**  
11 A Would block the transport of physical P or  
12 particulate P due to just the physical blocking of  
13 particles moving.  
14 **Q Describe, when we talk about particulate**  
15 **phosphorus, what would it look like if we looked at 01:41PM**  
16 **it.**  
17 A It would be too small to see.  
18 **Q Is it like -- would it look like dirt that**  
19 **washes off a field or just erosion?**  
20 A It would look like muddy water. 01:41PM  
21 **Q Muddy water, okay, and am I hearing you**  
22 **correctly that vegetation may filter out the mud**  
23 **from the water?**  
24 A It can, yes.  
25 **Q Okay. Does it necessarily filter out the mud 01:41PM**

131

**from the water?**  
A With varying degrees of effectiveness, yes.  
**Q In, I guess, it's 5F at the bottom of Page 7,**  
**Dr. Coale, you talk about the difficulties Dr. Olsen**  
**had in capturing edge of field runoff. 01:43PM**  
A Right.  
**Q Is there an established protocol for catching**  
**edge of field runoff?**  
A Not that I know of.  
**Q And 5G, which is on the top of Page 8, you're 01:43PM**  
**talking about, I guess, Dr. Fisher and Dr. Olsen's**  
**comments about the Karst geology.**  
A Uh-huh.  
**Q You say that, about four lines down, the soil**  
**surface slope, soil textural composition, talk about 01:43PM**  
**percentage of sand, silt and clay.**  
A Uh-huh.  
**Q Depth, bulk density and porosity of the soil**  
**that overlies the fractured limestone bedrock will**  
**determine runoff, infiltration and percolation 01:44PM**  
**potential of rainfall that falls on a particular**  
**site.**  
A Uh-huh.  
**Q Have you done any particular studies of those**  
**factors in the IRW that would prepare you to opine 01:44PM**

132

**about the extent of percolation or infiltration of**  
**water?**  
A No, I have not.  
**Q Do you know of anyone who's done that for the**  
**defendant? 01:44PM**  
A No, I don't.  
**Q Just a second. In 7H you begin to talk about**  
**assessment of potential P losses.**  
A Uh-huh.  
**Q Let me hand you what I have marked as Exhibit 01:46PM**  
**5 for Coale. I guess if I say I'm handing it to**  
**you, I better hand it to you.**  
A I thought it would come sooner or later.  
**Q Do you recognize this as one of the articles**  
**you have referenced in Subparagraph H? 01:46PM**  
A Yes.  
**Q Have you got a cough drop? You want a**  
**peppermint or something?**  
A I'm fine.  
**Q Looking at the left-hand column there of the 01:46PM**  
**first page, which is -- I'm not sure of the number,**  
**but it's the first page of the article, about**  
**halfway down that first paragraph, let me read the**  
**sentence and let's talk about it. In fact, US EPA,**  
**1996, maintains that eutrophication is a critical 01:47PM**

133

1 problem in most surface waters having impaired water  
 2 quality with agriculture being the major source of  
 3 causative nutrients in 50 percent of the lakes and  
 4 60 percent of the river miles determined to have  
 5 impaired water quality. Did I read that correctly? 01:47PM  
 6 A Yes, you did.  
 7 Q So would it be fair to say that people in your  
 8 profession have probably known since at least '96  
 9 about this problem and the role of agriculture in  
 10 it? 01:47PM  
 11 A I don't want any confusion that I work for the  
 12 EPA, and EPA is very different from scientists.  
 13 They're regulators. Okay?  
 14 Q Okay.  
 15 A So, yes, this references the EPA publication. 01:48PM  
 16 Q All right. Do you think this sentence is  
 17 generally accurate?  
 18 A I believe it's accurate.  
 19 Q Okay. Do you know of any reason why in the  
 20 Illinois River watershed agriculture would not be a 01:48PM  
 21 major source of causative nutrients of any  
 22 eutrophication in the water?  
 23 MR. McDANIEL: Object to the form. It's  
 24 outside the scope of his opinions offered in his  
 25 report. 01:48PM

134

Q This seems to me to be a highly studied  
 watershed?  
 A It's very -- I've been there. It's a very  
 highly studied watershed.  
 Q What's it like there? 01:50PM  
 A In what regard?  
 Q Just, I mean, what sort of facilities do they  
 use to study it?  
 A There are wells in the soil collecting soil  
 water. There's surface runoff flumes. There's 01:50PM  
 stream gauges. There's other instrumentation that I  
 don't recall the purpose but soil water monitoring  
 instrumentation across the watershed.  
 Q Okay.  
 A It's a very highly instrumented site. 01:51PM  
 Q How does it compare in size to the Illinois  
 River watershed?  
 A Oh, it's quite small. It's a small research  
 study site.  
 Q Okay. How do the soils there compare to the 01:51PM  
 soils in the Illinois River watershed?  
 A I've never compared them. I don't know.  
 Q What kind of soils do we have in the Illinois  
 River watershed?  
 A By name? I don't really know the names. 01:51PM

136

1 A I really am not prepared to comment on  
 2 eutrophication in waterways of waters within the  
 3 IRW.  
 4 Q What's your understanding generally of the  
 5 effect of nutrients on eutrophication of waterways? 01:49PM  
 6 A That the -- generally for fresh water systems,  
 7 the eutrophication cycle, which is the growth of  
 8 algae above what ecologists seem -- deem to be  
 9 acceptable levels, is fueled by nutrients injected  
 10 into that system. 01:49PM  
 11 Q And would phosphorus be one of those nutrients  
 12 generally?  
 13 A Generally phosphorus is one.  
 14 Q Now, this study, Exhibit No. 5, was done on a  
 15 small watershed in Pennsylvania; is that right? 01:49PM  
 16 A If my recollection is correct -- I'll have to  
 17 see which one this is. Hang on a second, please.  
 18 Q Sure.  
 19 A Yes. It's saying the FD-36 watershed is one  
 20 of them. 01:50PM  
 21 Q Okay, and you're looking on Page 268?  
 22 A Yes, sir.  
 23 Q And it's got a little map of the watershed or  
 24 a diagram of the watershed there; right?  
 25 A Yes, sir. 01:50PM

135

There are silt loams and silty soils. There's a  
 wide variety.  
 Q Okay. How does the elevation change in  
 watershed either WE-38 or FD-36 compare to the  
 elevation change in the Illinois River watershed? 01:52PM  
 A I don't know -- I don't think I can answer  
 that question.  
 Q Okay. Let's turn to Page 272, if we could,  
 Dr. Coale. I need to understand some things it  
 says. There in the right-hand column above the  
 runoff soil phosphorus interaction heading, the  
 paragraph above that -- 01:52PM  
 A Okay.  
 Q -- the first sentence of that says comparisons  
 of calculated and measured flow volumes both at the  
 runoff plot and whole site scale support the  
 assumption that storm runoff is generated primarily  
 by the near-stream surface-saturated areas. Could  
 you explain to me what that means?  
 A Interpreting those terms is that the near 01:53PM  
 stream -- it says where the runoff water is  
 generated from within the site. So runoff was more  
 common to be generated near the stream, near the  
 creek in that stream where the surface soil becomes  
 saturated with water. 01:53PM

137

1 **Q Okay. Would I have it correctly if it rained**  
2 **over the whole watershed uniformly --**  
3 A Right.  
4 **Q -- that most of the water that would be in the**  
5 **stream would be from the rain that fell near the** 01:53PM  
6 **stream?**  
7 A Most of the water that reached the stream by  
8 runoff would be generated --  
9 **Q By runoff, yeah.**  
10 A -- would be generated from the regions that 01:53PM  
11 are nearer the stream as opposed to regions further  
12 from the stream.  
13 **Q Okay. Would it then be fair to say that more**  
14 **of the phosphorus in the runoff would originate from**  
15 **the land near the stream than from the land farther** 01:54PM  
16 **from the stream?**  
17 A Well, if most of the runoff water is generated  
18 in the stream and you have to make an assumption  
19 about phosphorus concentrations, they're uniform,  
20 then most of the phosphorus runoff would be 01:54PM  
21 generated with that runoff water near the stream.  
22 **Q All right. The next sentence says, most**  
23 **importantly, though, from the perspective of**  
24 **potential for P transport, the maximum extent of the**  
25 **surface runoff producing areas for all observed** 01:55PM  
138

1 storms was within approximately 30 meters of the  
2 channel.  
3 A Uh-huh.  
4 **Q So is that why in your phosphorus indices**  
5 **you're concerned about nearness to a stream --** 01:55PM  
6 A Right.  
7 **Q -- as one of the factors?**  
8 A That's part of it, yes.  
9 **Q Okay. Is it -- is that 30-meter figure**  
10 **something that's unique to this particular watershed** 01:55PM  
11 **and not something you translate uniformly to every**  
12 **other watershed in the world?**  
13 A That's kind of -- that's a -- they have a good  
14 dataset here to show that 30 meters is a reasonable  
15 delineation, and it conforms with common practice 01:56PM  
16 that you kind of know the further -- but we never  
17 had a dataset to back that up. So it's been kind of  
18 adopted as the limit because this dataset basically  
19 supports what in practice has been observed.  
20 MR. ELROD: Are we about to explode? 01:56PM  
21 MR. NANCE: We're going to take off.  
22 MR. HAMMONS: Is that gas fixing to come  
23 out of the ceiling?  
24 MR. McDANIEL: Only on that side of the  
25 room, though. 01:56PM  
139

MR. HAMMONS: I figured there's an air  
block on that side.  
MR. ELROD: You'll be asleep in about ten  
seconds.  
A Where does that leave me? 01:56PM  
MR. McDANIEL: Leaves you sleeping on the  
desk.  
MR. ELROD: Exactly. When you wake up,  
you'll have no memory of this.  
MR. McDANIEL: But a good transcript.  
A Excuse me. I'm going to suck on one of these.  
If it becomes a problem, please let me --  
**Q It certainly doesn't bother me.**  
A Okay.  
**Q Are you aware of any comparable study in the** 01:57PM  
**Illinois River watershed that tailors the**  
**appropriate distance from a stream for that**  
**watershed?**  
A No, I've not seen that.  
**Q Okay. So in your profession, do you just use** 01:57PM  
**the 30 meters because that's the one that happened**  
**to be in this watershed?**  
A Yes, and, like I said before, it kind of  
conforms with observation, but this is a good  
dataset to back up that observation. 01:57PM  
140

**Q Does that mean that, going back to our earlier**  
**example with high Field 1, that you would expect**  
**water to run off it 30 meters if there were runoff?**  
A I don't know if I understand that question.  
**Q Okay. You say in this study that you get most** 01:57PM  
**of your runoff from 30 meters from the stream.**  
A Right.  
**Q We talked earlier about the high P Field 1,**  
**Field 2, Field 3 going down to a stream.**  
A Right. 01:58PM  
**Q Does that mean that it's a good rule of thumb**  
**that if it rains on Field 1 up high and there's**  
**runoff, that the runoff is going to go about 30**  
**meters?**  
A No. 01:58PM  
**Q Why is that?**  
A Because in Field 1 up high in your scenario,  
there's no stream. The stream is way down here in  
Field 3 or 4, correct, so, no, that wouldn't mean  
the same thing. 01:58PM  
**Q And why is that?**  
A Because if you have a surface water stream,  
then you -- there's at least a local water table  
there at the stream surface.  
**Q Okay.**  
141

1 A So that's what is controlling that distance  
2 from the stream.

3 Q And does that mean because the water table is  
4 maybe near the surface, it's less likely -- water is  
5 less likely to sink in? 01:58PM

6 A Correct, correct.

7 Q Have you done any personal study or  
8 observation in the Illinois River watershed so in  
9 our example we would know how far water would get  
10 from Field 1 onto Field 2? 01:59PM

11 A No, I have not.

12 Q Are you aware of anyone who has?

13 A No, I'm not.

14 Q Let's turn to Page 274, Dr. Coale. In the  
15 left-hand column, the first full paragraph, the 01:59PM  
16 second sentence there says, for instance, one might  
17 set P-management goals based solely on Mehlich III P  
18 contents for soils over the entire watershed. Do  
19 you see where I'm reading?

20 A Yes. 02:00PM

21 Q And next sentence says, nearly 60 percent of  
22 the soils over FD-36 are sufficiently high in P,  
23 over 100 kilograms per kilogram, so there would be  
24 no further response to P applications. Let me stop  
25 and ask you where the 100 milligrams per kilograms 02:00PM

1 4 2

1 comes from as an economic critical level in that  
2 watershed; do you know?

3 A That's probably the Penn State University  
4 recommendation since this study was done in 02:00PM  
5 Pennsylvania, but I can't say that for sure.

6 Q All right. So at least in this little  
7 watershed, 60 percent of the soil is above that?

8 A Correct.

9 Q Okay. A little farther down it says -- well,  
10 let's read the next sentence. This suggests not 02:01PM  
11 applying P to those areas because its continued  
12 application, particularly to 40 percent of the  
13 watershed above 200 milligrams per kilogram Mehlich  
14 III P, would result in further P enrichment of  
15 runoff and increase in P export. So they're saying 02:01PM  
16 if you put more phosphorus on that area, you're  
17 going to have more enrichment and more increase in  
18 the P export?

19 MR. McDANIEL: Object to the form.

20 A I think they were saying, excuse me, that the 02:01PM  
21 potential might be there for increased -- increasing  
22 the P further, and that's the only factor what was  
23 changing that perhaps the export would be increased.

24 Q I don't see potential in that sentence.

25 MR. McDANIEL: What's the question? 02:02PM

1 4 3

Q Well, let me read the sentence again and see  
if you --

A Okay.

Q This suggests not applying P to those areas,  
meaning the 60 percent where it's over the level -- 02:02PM

A Uh-huh.

Q -- because its continued application,  
particularly to the 40 percent of the watershed area  
above 200 milligrams per kilogram Mehlich III P,  
would result, would result in further P enrichment 02:02PM  
of runoff and increase in P export. It doesn't say  
there's potential. It says it would result, doesn't  
it?

A Right, that's what it says, but they're using  
that as an introduction to the area, variable source 02:02PM  
area that says -- what they're suggesting is to pay  
attention to where the runoff is being generated  
from within the watershed, those variable source  
areas, and to avoid those variable source areas when  
you are applying manure to the land. 02:03PM

Q Well, is this sentence scientifically correct?

MR. McDANIEL: Object to the form. You are  
excerpting the document. It's misleading.

A I would say that that sentence in isolation  
could be correct in some soils and some locations 02:03PM

1 4 4

and maybe not in others.

Q So the author's got it partly right and partly  
wrong?

MR. McDANIEL: Object to the form.

A My interpretation of what the authors are 02:03PM  
doing with that sentence is using it to introduce  
the following part of that paragraph, which talks  
about the variable source areas, and their  
recommendation that if you are in -- if you want  
to utilize -- well, in this case it's not litter; 02:04PM  
it's dairy manure I believe, but if you want to use  
manure on those sites, you're -- they are suggesting  
you look at where the litter is being generated from  
and avoid application of those sites.

Q Dr. Coale, all I'm interested in right now is 02:04PM  
that further -- it says further continued  
application would result, would, not might, but  
would result in further P enrichment in runoff. Is  
that scientifically correct?

MR. McDANIEL: Object to the form. It's 02:04PM  
been asked and answered.

MR. NANCE: I'm breaking it down in pieces  
here.

MR. McDANIEL: You asked him to give you  
his explanation of the statement, and he's done so 02:04PM

1 4 5

1	twice now.			discussing. He told you if you -- you can read into	
2	A Okay. What I'm saying is that on certain			the Record the balance of paragraph that starts with	
3	sites, if you increase the soil test P level, you			the world alternatively. So would you do that?	
4	can have resulting increase in runoff. In other			A Okay. Alternatively, incorporation of the VSA	
5	sites, that might not happen.	02:05PM		hydrologic concepts discussed previously and the	02:07PM
6	<b>Q Why might it not happen?</b>			recognition of the similarity between patterns of P	
7	A If there's no runoff generated on that site,			concentration in stream flow and P content in near	
8	you would not have increased runoff from P.			stream soils suggest that P-management goals should	
9	<b>Q And if there were runoff generated from that</b>			focus on the near stream areas rather than the whole	
10	<b>site?</b>	02:05PM		watershed.	02:08PM
11	A Then you may or may not see more P moving. As			<b>Q Okay. Then the next paragraph, controlling P</b>	
12	many factors, as we said before, that have to be			<b>application in the near stream runoff producing</b>	
13	assessed on each site to determine how much			<b>areas rather than areas further from channel appears</b>	
14	phosphorus may be transported off that site.			<b>to have the greatest potential to decrease P export</b>	
15	<b>Q Well, the question here is enrichment in</b>	02:05PM		<b>in stream flow; is that correct?</b>	02:08PM
16	<b>runoff, of runoff. So that assumes there's runoff,</b>			A That's what it says here.	
17	<b>doesn't it?</b>			<b>Q Why would that have the greatest potential --</b>	
18	A The authors' words are that there is			<b>have a greater potential than cutting off all P</b>	
19	enrichment in runoff.			<b>application?</b>	
20	<b>Q And increase in P export?</b>	02:06PM		A I don't interpret it saying that it would.	02:08PM
21	A That's what the authors wrote.			<b>Q Well, if you stopped all P application, would</b>	
22	<b>Q Okay. Are the authors right or wrong?</b>			<b>you have an even greater potential to decrease the P</b>	
23	MR. McDANIEL: Object to the form.			<b>export in stream flow?</b>	
24	A The authors -- without knowing what the			A I think what the authors are getting at here	
25	specific site they are referring to, they could be	02:06PM		is that the -- if you're trying to strike a balance	02:09PM
	1 4 6			1 4 8	
1	right or could be wrong.			between management of a farm and minimizing or	
2	<b>Q Okay. The next sentence says, however,</b>			reducing the risk of phosphorus loss in runoff,	
3	<b>recommending limited application of P to over half</b>			surface runoff, then one way to take a step towards	
4	<b>the watershed area could restrict farmers with</b>			reducing that risk is to focus manure applications	
5	<b>confined animal operations.</b>	02:06PM		on those portions of the landscape where you don't	02:09PM
6	A Correct.			expect runoff to be generated, and if you are going	
7	<b>Q Is that a true sentence?</b>			to do that as a step to help reduce the potential	
8	A That's a truly read sentence.			for phosphorus runoff with runoff water, then that's	
9	<b>Q Is it factually true?</b>			a good practice to take.	
10	A That if a farmer is utilizing manure and a	02:06PM		<b>Q That's a good step?</b>	02:09PM
11	limitation on the amount of acreage that manure may			A That's a good step to take, correct.	
12	be applied to was put in place, then, yes, it would			<b>Q If you wanted to absolutely minimize the</b>	
13	restrict this management.			<b>runoff, would you do so by not putting any more</b>	
14	<b>Q Okay. Dropping down to the next paragraph --</b>			<b>phosphorus in the watershed?</b>	
15	MR. McDANIEL: Let me just interpose an	02:07PM		MR. McDANIEL: Object to the form.	02:09PM
16	objection to the lack of completeness of the			A That would be a much more dramatic step to	
17	examination for not reading the balance of that			take.	
18	paragraph into the Record. Go ahead.			<b>Q Okay. Next sentence, from the farmers'</b>	
19	<b>Q Well, Dr. Coale, you can read the balance of</b>			<b>perspectives, this means less land area would be</b>	
20	<b>the paragraph, the paragraph above.</b>	02:07PM		<b>impacted, therefore, allowing more land area</b>	02:10PM
21	A I don't understand what you are asking me to			<b>available for manure application. Did I read that</b>	
22	do.			<b>correctly?</b>	
23	MR. McDANIEL: Okay. My objection was that			A Yes, you did.	
24	he moved on in his examination without getting into			<b>Q Okay, and so would it be fair to say that</b>	
25	the Record the balance of that paragraph you were	02:07PM		<b>taking the small step lets farmers keep applying</b>	02:10PM
	1 4 7			1 4 9	



1	<b>more phosphorus than taking the big step?</b>			you're going to see Version 2, Version 3, Version 4,	
2	A That's correct.			Version 5 come on as we understand how things work	
3	<b>Q Okay, and isn't part of the issue here really</b>			better.	
4	<b>that we want to make it easier on farmers to keep</b>			<b>Q Okay.</b>	
5	<b>using, in this case, cattle manure?</b>	02:10PM		MR. McDANIEL: Bob, if you are at any point	02:13PM
6	MR. McDANIEL: Object to the form.			ready to go in a little different direction, I could	
7	A Part of the issue is to move a given farmer			stand a convenience break.	
8	from -- to a production practice that has less risk,			MR. NANCE: Let's take a convenience break.	
9	and it's a step-by-step incremental process of			VIDEOGRAPHER: We're now off the Record.	
10	education, and I interpret what these authors are	02:11PM		The time is 2:15 p.m.	02:13PM
11	saying is that if -- as a step in that education			(Following a short recess at 2:15 p.m.,	
12	process backed up by their science, that says if			proceedings continued on the Record at 2:22 p.m.)	
13	they have dairy manure to apply to the landscape and			VIDEOGRAPHER: We are back on the Record.	
14	they needed that for the nitrogen supplying capacity			The time is 2:22 p.m.	
15	for growing the silage or whatever they are growing,	02:11PM		<b>Q Dr. Coale, I've handed you what I've marked as</b>	02:21PM
16	that's a good step to help reduce the risk for			<b>Exhibit No. 6. Do you recognize that as one of the</b>	
17	phosphorus loss because those portions of the			<b>articles you cited in Paragraph 5H of your report?</b>	
18	landscape that are further distance from the stream			A Yes.	
19	are much less likely to generate runoff water in the			<b>Q Okay. This is another one where I'd sure like</b>	
20	first place.	02:11PM		<b>you to pronounce the lead authors's last name for</b>	02:21PM
21	<b>Q Okay. What's the step after this?</b>			<b>me?</b>	
22	A In this scenario?			A Gburek.	
23	<b>Q Well, what's the step after your phosphorus</b>			<b>Q Gburek, okay, and Dr. Sharpley and others were</b>	
24	<b>index?</b>			<b>on this report; right?</b>	
25	MR. McDANIEL: Object to the form.	02:12PM		A Right.	02:22PM
	150			152	
1	A In general?			<b>Q Okay. Let's see the extent to which you agree</b>	
2	<b>Q In general.</b>			<b>with certain of the statements in this article.</b>	
3	A Globally? You do a phosphorus index			<b>Upper right-hand column there on the first page, the</b>	
4	assessment on the site. The outcome of that			<b>rapid growth and intensification of the livestock</b>	
5	assessment gives you some management guidelines that	02:12PM		<b>industry in certain areas of the USA and Europe have</b>	02:22PM
6	say things -- you know, you have a low, medium,			<b>created imbalances between P input in feed and</b>	
7	high, very high loss for P loss or whatever the			<b>fertilizer and its output in produce with</b>	
8	outcome may be, and then you go back and look at how			<b>references. Is that a true statement as far as</b>	
9	you might change management of that property or that			<b>you're concerned?</b>	
10	field so that your risk is decreased.	02:12PM		A Yes.	02:22PM
11	<b>Q Is there anything in the pipeline of your</b>			<b>Q Okay. The next sentence, on a national basis,</b>	
12	<b>profession that's better than a phosphorus index yet</b>			<b>an annual P surplus of 26 kilograms per hectare</b>	
13	<b>to come?</b>			<b>exists in the US, and I don't care about Europe, but</b>	
14	A I would say if we're working now with Version			<b>does that sound a good figure for the excess in the</b>	
15	1 of a phosphorus index, there's Version 2 in the	02:13PM		<b>United States?</b>	02:22PM
16	works. There's several updates on the way, on the			A I'm not familiar with the calculation of	
17	way now, and those are being developed based on what			excess on a national basis, nor in the UK.	
18	we've learned over the last several years of how to			<b>Q I'd be surprised if you were. The next</b>	
19	improve them, and that was the goal from the very			<b>sentence, sir, actual surpluses are more dramatic</b>	
20	beginning when the phosphorus indices were first	02:13PM		<b>regionally because the areas where feed is produced</b>	02:23PM
21	being developed. I think almost universally the			<b>have become fragmented from those where livestock</b>	
22	folks that were involved in developing them were			<b>are raised, with references. Is that a correct</b>	
23	saying this is the first cut and these things need			<b>statement?</b>	
24	to be improved and refined and updated over the			A Yes.	
25	years as we learn more over the years. So I think	02:13PM		<b>Q And in our case, would that be illustrated to</b>	02:23PM
	151			153	

1	the extent the poultry feed fed in the Illinois		Q It's FD-36?	
2	River watershed grows somewhere -- is grown		A Correct.	
3	somewhere else?		Q What's the source of the Mehlich III P	
4	A For the most part, I believe that's true.		categories that are there, over 200 excessive, 100,	
5	Q Okay. That means the growth is fragmented	02:23PM	200, no crop response; do you know where those	02:26PM
6	from the consumption?		numbers come from?	
7	A Correct.		A I would speculate. I'm not promising this is	
8	Q Okay. Next sentence, aggravating the		a correct speculation. It would be from the Penn	
9	situation even further, manure applications within		State University agronomy recommendations.	
10	the livestock production areas are typically based	02:23PM	Q And do you know what those are based on, I	02:26PM
11	on crop N requirements. The desire is to minimize		mean, how they arrive at those numbers?	
12	the purchase of commercial fertilizer and the risk		A Oh, I suspect they're -- well, I can't assume,	
13	of NO3 leaching into groundwater. Is that a correct		but most land grant universities who generate	
14	statement?		recommendations like this, they're based on field	
15	MR. McDANIEL: Object to the form.	02:23PM	studies over many years and many sites to determine	02:26PM
16	Q Is that a true statement?		where the responsive range to phosphorus is for	
17	MR. McDANIEL: Object to the form.		certain crops.	
18	A Well, obviously in the year 2000 the authors		Q Okay. Let's go to Page 143, Dr. Coale. Let's	
19	thought it was.		look at the last paragraph above the acknowledgement	
20	Q Okay. Do you agree with that statement?	02:24PM	heading.	02:27PM
21	A I'm trying to rewind my brain nine years.		A Okay.	
22	Nine years ago, it was probably an accurate		Q Finally, and perhaps most importantly, the	
23	statement.		modified PI proposed is still only an interim	
24	Q What's inaccurate about it today?		measure. Is that a true sentence?	
25	A I think if you -- right now it's -- my tongue	02:24PM	A I don't know what they're referenced to.	02:27PM
	154		156	
1	is tied a little bit. The phrase typically based on		Interim measure to what?	
2	crop nitrogen requirements is less common, less		Q That was going to be my next question.	
3	pervasive now than it was nine years ago.		A Then I'll answer it, I don't know what that	
4	Q Is that because there's more phosphorus based		means.	
5	systems now than there were nine years ago?	02:24PM	Q Okay. Next sentence, it provides immediate	02:27PM
6	A Yes.		direction for P management that accounts for the	
7	Q Okay. Next sentence, the N-P ratio of manure,		spatially variable source and transport properties	
8	two to one to six to one, is lower than the crop		of the watershed. I think we understand that.	
9	uptake, seven to one to eleven to one, so N-based		A Okay.	
10	manure management results in more P being added to	02:24PM	Q However, we must remember the figures	02:27PM
11	the soil than the soil requires. Without getting		presented in the introductory portion of the paper,	
12	into whether we're more nitrogen or phosphorus based		colon, an annual excess of 26 kilograms of	
13	now, at least in terms of 2000 when things were		phosphorus per hectare in the USA. We'll forget	
14	nitrogen based, was that a true statement?		about Great Britain. A problem further complicated	
15	A Yes. We've already mentioned that today.	02:25PM	by further uneven distribution typically tied to	02:28PM
16	Q Final sentence of that paragraph, in total		concentrated animal production, and did I read that	
17	these factors contribute to an increased risk of P		correctly?	
18	transport from agriculture land to surface waters.		A Yes, you did.	
19	Is that a true statement today?		Q Okay. While we're developing tools to address	
20	A Yes.	02:25PM	immediate P management in the -- at the watershed	02:28PM
21	Q Okay. Dr. Coale, let's turn over to Page 132,		scale, we should also be working to reduce these two	
22	and is the little diagram or map on Page 132 part of		excesses. Achieving an overall P balance is the	
23	the same watershed that we talked about a moment		ultimate answer to P management at the watershed	
24	ago?		scale. Now, did I read that correctly?	
25	A I believe it is.	02:25PM	A Yes, you did.	02:28PM
	155		157	

1 **Q What does that mean, sir?**  
2 A What I interpret the author is meaning --  
3 saying -- meaning by that last sentence is that at  
4 the watershed scale an overall P balance would mean  
5 that there is as much phosphorus brought into the 02:28PM  
6 watershed as there is that leaves the watershed.  
7 **Q Do you agree that that's the ultimate answer**  
8 **for watershed scale management?**  
9 MR. McDANIEL: Object to the form.  
10 A Ultimate answer to what question? 02:29PM  
11 **Q I think they're talking about in the sentences**  
12 **above that the excess of phosphorus and the uneven**  
13 **distribution of it. I mean, read it and satisfy**  
14 **yourself, but that's the way I read it.**  
15 A That if you're in a given watershed, whatever 02:29PM  
16 watershed it might be, that if you're bringing more  
17 phosphorus into the watershed than is being removed  
18 in the watershed, then you're going to be  
19 accumulating phosphorus in that watershed.  
20 **Q Okay.**  
21 A And I think that's what they're getting at.  
22 **Q Aren't they getting at something more and,**  
23 **that is, that as much should go out as comes in?**  
24 A That would be balance, right.  
25 **Q Okay. Do you agree that that's the 02:30PM**  
158

1 appropriate goal?  
2 MR. McDANIEL: Object to the form.  
3 A In my mind, that would be an appropriate goal  
4 if there was a documented problem you're trying to  
5 solve. 02:30PM  
6 **Q Is there a documented problem in the Illinois**  
7 **River watershed?**  
8 MR. McDANIEL: Object to the form.  
9 **Q Is there a documented problem in the Illinois**  
10 **River watershed with excess of phosphorus? 02:30PM**  
11 MR. McDANIEL: Object to the form. It's  
12 outside the scope of the opinions offered in his  
13 report.  
14 A If the question is whether in the Illinois  
15 River watershed there's a water quality issue in the 02:30PM  
16 stream, in the open water, that's something I can't  
17 answer.  
18 **Q Okay. Is there a problem in the Illinois**  
19 **River watershed with there being a substantial**  
20 **amount of land with artificially high STPs? 02:31PM**  
21 MR. McDANIEL: Object to the form. Plus,  
22 it's outside the scope of his --  
23 A Okay. One -- make sure I understand what you  
24 are getting at. Artificially high is -- has what  
25 meaning? Can you define that for me? 02:31PM  
159

**Q How would you define it?**  
A I wouldn't use it.  
MR. McDANIEL: Excuse me. It's your  
question, Bob. He asked you a fair question.  
**Q Is there a documented problem in the Illinois 02:31PM**  
**River watershed with disturbingly high STPs brought**  
**about by the land application of the defendants'**  
**poultry litter in some of the watershed?**  
MR. McDANIEL: Objection to form. It's  
argumentative. 02:32PM  
A I don't know what you mean by disturbingly  
high. It seemingly is artificially high. I don't  
know what you are referring to.  
**Q Are you at all disturbed by the STPs that you**  
**have seen in the data you've reviewed for areas 02:32PM**  
**where people have either applied litter or are**  
**asking to apply litter?**  
MR. McDANIEL: Object to the form.  
A I've seen soil test data used by Dr. Johnson  
that I was disturbed by because just in my 02:32PM  
professional opinion had to be absolutely wrong,  
some soil test values and some that were up in the  
tens of thousands, which I don't think can be right.  
**Q All right. Do you find anything that any soil**  
**test values that you've seen from Dr. Johnson, which 02:32PM**  
160

**you don't think are just wrong, which disturb you?**  
MR. McDANIEL: Object to the form.  
A Disturb me relative to what?  
**Q Either you're disturbed or you're not. It's**  
**your own judgment. 02:33PM**  
MR. McDANIEL: Object to the form.  
A I rarely get disturbed about data. I don't  
know how to answer that question. I don't know what  
disturbed means.  
**Q Do you know that the State of Arkansas has 02:33PM**  
**said that Benton and Washington Counties are**  
**nutrient surplus areas?**  
MR. McDANIEL: Object to the form.  
A I'm not aware of that.  
**Q Are you aware that the State of Oklahoma 02:33PM**  
**considers the Illinois River watershed a nutrient**  
**impaired area?**  
A I have read that.  
**Q Is that just something that's morally neutral**  
**to you? 02:34PM**  
MR. McDANIEL: Object to the form.  
A I'm trying to address questions on a  
scientific point of view, and moral issues, I don't  
know how to respond to that. I'm trying to be  
honest with you. 02:34PM  
161

1 **Q I appreciate your honesty. So as far as**  
 2 **you're concerned, there's no phosphorus STP problem**  
 3 **in the Illinois River watershed?**

4 MR. McDANIEL: Object to the form.

5 A I did not say that. 02:34PM

6 **Q Then what is the problem?**

7 MR. McDANIEL: Object to the form.

8 A From what I know about the Illinois River  
 9 watershed and in any other watershed probably  
 10 anywhere on the face of the earth, there's going to 02:34PM  
 11 be sites where, from an optimum management of that  
 12 site, you would find there would be -- that the soil  
 13 P levels would be elevated to a point where it would  
 14 contribute to phosphorus loss from that site.

15 There's other sites which that wouldn't be the case. 02:35PM  
 16 So a general statement about the Illinois River  
 17 watershed, I can't and hopefully won't answer  
 18 because I'm firmly convinced it has to be absolutely  
 19 a site-specific assessment.

20 **Q But in the Illinois River watershed, there are** 02:35PM  
 21 **sites with STPs high enough that they seriously**  
 22 **contribute to transport of phosphorus off the site?**

23 MR. McDANIEL: Object to the form.

24 A I would suspect that there are sites that when  
 25 evaluated properly, using a tool like a phosphorus 02:35PM

162

1 site index or a similar type tool, I would  
 2 professionally expect to find sites that would be --  
 3 have elevated concern along with sites that did not  
 4 have elevated concern.

5 **Q Have you looked at the results of any** 02:35PM  
 6 **phosphorus index analyses of any sites in the**  
 7 **Illinois River watershed?**

8 A I've looked at some results of some phosphorus  
 9 index studies that were done by the University of  
 10 Arkansas, but I'm not -- I can't say now whether 02:36PM  
 11 they were in the watershed or outside the watershed.  
 12 I don't know where they exactly were.

13 **Q Were those phosphorus index reports in your**  
 14 **considered materials?**

15 A Yes. 02:36PM

16 **Q You're talking about like a study or an actual**  
 17 **test result?**

18 A Oh. It was a study, research study where they  
 19 utilized the phosphorus index to generate the  
 20 dataset. 02:36PM

21 **Q Okay. Have you looked at any actual**  
 22 **phosphorus index test results?**

23 A No, I have not.

24 **Q Are you aware of any proposal by the**  
 25 **defendants in this case to balance phosphorus import** 02:37PM

163

and export in the watershed?

MR. McDANIEL: Object to the form.

A I'm not aware of that.

**Q Do you believe any such proposal will be made**  
**to the court?** 02:37PM

MR. McDANIEL: Object to the form.

A Not that I know of. I have no knowledge of  
 that.

**Q Are you aware of any proposal by the**  
**defendants that would actually reduce the STP levels** 02:37PM  
**of high phosphorus lands in the watershed?**

MR. McDANIEL: Object to the form.

A I'm not aware of any proposed actions that  
 they would take in that regard.

**Q Are you aware of any proposal they will make** 02:38PM  
**to the court --**

A No.

**Q -- to try to reduce the level of STP?**

MR. McDANIEL: Object to the form.

**Q Let's look at Section 6 of your report on Page** 02:38PM  
**9, Dr. Coale. In Section 6 there, and I'll call it**  
**the introductory part because it doesn't have a**  
**letter, you discuss something that was in Dr.**  
**Engel's report?**

A Correct. 02:39PM

164

**Q Okay. Just a moment. I don't suppose you**  
**happen to have Dr. Engel's report on you?**

A No, sir.

**Q I have a copy, and I don't intend to make it**  
**an exhibit, but let me flip open to Page 37 and see** 02:39PM  
**if that's the part of Dr. Engel's report that you**  
**were talking about.**

A The part that's highlighted?

**Q What was your question again, Doctor?**

A The part that you have highlighted here? 02:40PM

**Q Well, Section 8.1.**

A I believe it is.

**Q Let me show you, Dr. Coale, what --**

A You want this one back?

**Q Keep it handy. We may want to talk about it** 02:40PM  
**again. Let me show you what I've marked as Exhibit**  
**No. 7 Coale and see if that is the Dr. Sharpley**  
**article that you were talking about, you and Dr.**  
**Engel are both talking about here I think.**

A It appears to be, yes. 02:41PM

**Q Let's turn -- what was your concern about Dr.**  
**Engel's report, and if you want to look at it to**  
**answer that, you may.**

A Hang on a second. Oh, my concern was stemmed  
 from the fact that Dr. Engel proposed an 02:41PM

165

1 across-the-board, uniform, generic estimate that 5  
 2 percent of the poultry litter P that applied to  
 3 pastures was transported to natural surface water  
 4 vehicles, runoff pathways, and the point I'm trying  
 5 to make is that to have a uniform application of a 02:42PM  
 6 any value, more or less 5 percent happens to be the  
 7 one he picks from Sharpley, probably is not an  
 8 accurate representation because back to our  
 9 site-specific nature of how runoff is going to be  
 10 generated and how P is going to be transported, I 02:42PM  
 11 think applying a constant uniform 5 percent loss  
 12 factor is just a gross overgeneralization. That's  
 13 the point I was trying to make.  
 14 **Q Okay. Let's look at Page 378 of Exhibit 7.**  
 15 A Okay. 02:43PM  
 16 **Q And there's a couple little diagrams there.**  
 17 **Let's look at the lower of the two, which is called**  
 18 **Figure 3.**  
 19 A Okay.  
 20 **Q Have you seen that before?** 02:43PM  
 21 A Yes, I have.  
 22 **Q That shows, of course, P runoff 5 percent.**  
 23 A Correct.  
 24 **Q Okay. So does Dr. Engel say more than that**  
 25 **about the P runoff?** 02:43PM

166

1 A I believe he just accepted that number at face  
 2 value and applied it across the whole area.  
 3 **Q Okay. Let's look back at 377. We'll back up**  
 4 **just a little bit. Let's walk through this together** 02:44PM  
 5 **and see if you agree with the statements in this**  
 6 **report. There in the lower right-hand corner**  
 7 **there's a bolded heading fate of land applied**  
 8 **phosphorus in poultry operations; do you see that?**  
 9 A Yes, I do.  
 10 **Q The fate of P in typical poultry operations in** 02:44PM  
 11 **the United States is shown in Figure 3, and that's**  
 12 **the figure we just looked at; right?**  
 13 A Yes.  
 14 **Q Okay. Typically less than one-third of feed P**  
 15 **is utilized by poultry, with the remainder excreted** 02:44PM  
 16 **in manure and applied to land for crop use, and it**  
 17 **cites a reference.**  
 18 A Uh-huh.  
 19 **Q Do you agree with that statement?**  
 20 A I'd have to rely on that reference. I don't 02:44PM  
 21 really know that percentage.  
 22 **Q Okay. Would you generally rely on Dr.**  
 23 **Sharpley and Sheri Herron and Dr. Daniel to know**  
 24 **their stuff on a point like that?**  
 25 A Yes, I would. 02:45PM

167

**Q Okay. Phosphorus uptake and harvest removal**  
**by crops ranges from 10 to 40 percent of applied P**  
**due to low crop demand compared to N and the rapid**  
**and only slowly reversible sorption of P to**  
**aluminum, iron and calcium compounds in soil, and it** 02:45PM  
**cites to Figure 3 again; right?**  
 A Correct.  
**Q Would you agree with that statement?**  
 A It appears to be accurate.  
**Q Okay. The next statement, phosphorus loss in** 02:45PM  
**surface runoff is generally greater than in**  
**subsurface flow and depends on the rate, time, and**  
**to the next page, method of P application. The form**  
**of fertilizer or manure applied in the amount --**  
 A Hang on. I lost you there. 02:45PM  
**Q It's between the two pictures.**  
 A Sorry.  
**Q Yeah, they hid it there. Depends on the rate,**  
**time and method of P application, the form of**  
**fertilizer or manure applied and the amount and time** 02:46PM  
**of rainfall after application, and then it's got**  
**references.**  
 A Uh-huh.  
**Q Do you agree with that statement?**  
 A I agree that, yeah, they're mentioning all the 02:46PM

168

different factors that need to be considered when  
 looking at phosphorus loss in runoff.  
**Q Okay. Next sentence, overall -- excuse me.**  
**Leaching of P can occur in sandy, organic or peaty** 02:46PM  
**soils, those with low P adsorption capacities, and**  
**those with substantial preferential flow pathways.**  
**Do you agree with that?**  
 A It can, yes.  
**Q Okay. Next sentence, overall -- and this**  
**takes us over to Page 389 -- P loss is agronomically** 02:46PM  
**small, generally less than 2 kilograms of phosphorus**  
**per hectare, and double bracket, less than 1.75**  
**pounds per acre, representing a minor proportion of**  
**P applied as fertilizer or manure, generally less**  
**than 5 percent. Do you agree with that proposition?** 02:47PM  
 A Again, I'd have to rely on the authors for the  
 5 percent number. I wasn't -- I didn't follow the  
 calculations through there.  
**Q Is your complaint with Dr. Engel that he said**  
**5 percent and Dr. Sharpley, at least in the text,** 02:47PM  
**says less than 5 percent?**  
 MR. McDANIEL: Object to the form.  
 A No, sir. I made that comment about Dr.  
 Engel's because I think what Dr. Sharpley in this  
 paper with his co-authors is trying to point out is 02:47PM

169



1 kind of a general relative scale of things for them  
 2 to form. I mean, this is not a highly technical  
 3 article. It's more of a pseudo technical article,  
 4 if you will, and I think it's meant to put things in  
 5 relative perspective, and that's where the 5 percent 02:47PM  
 6 came from. My concern I had was that if someone --  
 7 someone like Dr. Engel, who knowingly or unknowingly  
 8 applied a generality to a wide range of specific  
 9 conditions, it may be an appropriate number for some  
 10 sites and it might not be an appropriate number for 02:48PM  
 11 other sites.

12 My point comes back to, I don't think you can  
 13 apply a percent loss factor to all the landscape in  
 14 the IRW uniformly. It has to be done much more  
 15 specifically on a site-by-site basis. 02:48PM

16 **Q So Dr. Sharpley and his colleagues should not**  
 17 **have used the word overall in that last sentence?**

18 MR. McDANIEL: Object to the form.  
 19 A No, sir. I think I already mentioned what I  
 20 thought their intent was, is to be a general 02:48PM  
 21 guidance document, a general perspective of relative  
 22 scales for someone who had much less knowledge than  
 23 the authors did.

24 **Q That's not what they say.**

25 A Well, sorry. 02:48PM

170

1 **Q I mean, they don't say they're writing for the**  
 2 **uninformed, do they?**

3 A No, but this is the Journal of Soil & Water  
 4 Conservation, which is a more publicly read journal  
 5 than others. 02:49PM

6 **Q Is there some truth that the public doesn't**  
 7 **get that it ought to?**

8 A No. I'm just saying it's probably written at  
 9 a level for a more general consumption than, for  
 10 example, a readership of the Journal of 02:49PM  
 11 Environmental Quality that has a different  
 12 readership.

13 **Q Are you saying Dr. Sharpley was inaccurate**  
 14 **when he said overall or generally less than 5**  
 15 **percent?** 02:49PM

16 A Not at all.

17 **Q Okay. Let's turn over to Page 380. There's**  
 18 **Table 2 at the top of the page. Do you see that?**

19 A Yes.

20 **Q And is that, in fact, reporting the results of** 02:49PM  
 21 **a study done in Oklahoma?**

22 A According to the title, yes.

23 **Q Are you familiar with this table?**

24 A It's been a long, long time since I've looked  
 25 at it. 02:50PM

171

**Q Let's look at it for just a minute and see if**  
**we can agree on what it says. It talks in terms of**  
**being a phosphorus budget for poultry litter**  
**application. Do you see that just in the title**  
**above?** 02:50PM

A Uh-huh.

**Q Okay. Phosphorus uptake by Bermuda grass and**  
**total phosphorus load in surface and subsurface flow**  
**from a Ruston fine sandy loam in Oklahoma. Okay?**

A Okay. 02:50PM

**Q Along the left-hand side vertically, we've got**  
**some years set out; is that right?**

A Okay.

**Q It says before application, '89 and '90;**  
**right?** 02:50PM

A Correct.

**Q During application, '91, '92 and '93?**

A Uh-huh.

**Q And after application '94 through '99; right?**

A Right. 02:51PM

**Q The second column appears to me to be litter**  
**added in terms of kilograms per hectare per year?**

A Litter phosphorus added.

**Q You are correct, sir.**

A Yes.

172

**Q The next two columns talk about Bermuda grass;**  
**right.**

A Correct.

**Q There's the yield of the Bermuda grass and the**  
**phosphorus uptake of the Bermuda grass?** 02:51PM

A Correct.

**Q Okay. Then there is total P loss and flow is**  
**kind of the next two columns; right?**

A Yes.

**Q Surface and subsurface?** 02:51PM

A Uh-huh.

**Q And then on the right-hand column, right-hand**  
**side there's P balance; is that right?**

A That's what it says, yes.

**Q Okay. Now, in this chart do the years '89 and** 02:51PM  
**'90 reflect kind of the baseline before the**  
**experiment started?**

A I would presume it does.

**Q Okay, and then for three years, am I reading**  
**this correctly, they applied 180 kilograms per** 02:51PM  
**hectare per year of litter phosphorus?**

A 140.

**Q Excuse me. 140. You are correct again.**

A Okay.

**Q And then in '94 to '99, they didn't apply any?** 02:52PM

173



1 A Correct.

2 **Q Okay. The next column shows the Bermuda grass**

3 **yield and shows how it went up after the phosphorus**

4 **was applied; right?**

5 A Uh-huh. 02:52PM

6 **Q And then began to decline after they stopped**

7 **applying it. The next --**

8 A Which is probably a large result to the

9 nitrogen being applied, not necessarily the

10 phosphorus being applied. 02:52PM

11 **Q Okay. The phosphorus uptake is in the next**

12 **column. Does that represent the phosphorus taken up**

13 **by all of that Bermuda grass?**

14 A I presume it does, yes.

15 **Q And, again, at the baseline it's 5.9 and 6.4 02:52PM**

16 **kilograms per hectare per year; right?**

17 A Correct.

18 **Q And it jumps when they apply the litter.**

19 A Uh-huh.

20 **Q Let's look at the total P in the flow. The 02:53PM**

21 **baseline is two-tenths kilogram per hectare per**

22 **year; is that right?**

23 A That's correct.

24 **Q Did I read that correctly, and for the surface**

25 **flow? 02:53PM**

174

1 A Surface flow.

2 **Q Yes, sir. Now, what happens during the**

3 **application of the litter to the three years to the**

4 **surface flow?**

5 A The '91, '92, '93 years, when there's 02:53PM

6 application occurring, the P loss in surface flow

7 was elevated above the baseline.

8 **Q Was elevated considerably above the baseline,**

9 **wasn't it? In 1991 it would be 19 times the**

10 **baseline; right? 02:53PM**

11 A Well, it's -- I don't have the math, but it

12 might be 19 times if I do the math on that.

13 **Q Okay. 1992, it would be about 25 times the**

14 **baseline?**

15 A Okay. 02:54PM

16 **Q And in 1993 there it would be -- we're both**

17 **going to get tasked here.**

18 A Right, something greater.

19 **Q Something greater, 39 times the baseline**

20 **perhaps? 02:54PM**

21 A Uh-huh.

22 **Q And then it begins to drop down in the**

23 **following years, right, after they stop declining?**

24 A Right. '94 is less than '93.

25 **Q Okay, but six years after they stopped, it's 02:54PM**

175

still nine-tenths of a kilogram per hectare per

year; right?

A Correct.

**Q It's -- that would be over four times the**

**baseline? 02:54PM**

A Correct.

**Q Now, is that surface flow and the period of**

**application, that comes in large part, does it not,**

**from the soluble phosphorus in the litter itself?**

A Presumably. 02:54PM

**Q Okay, and then after the application stopped,**

**it would be because the STP had been elevated, or**

**would it not?**

A Well, there still may be some direct result

from litter that's still on the soil surface. 02:55PM

**Q So it would be a combination of that and the**

**increased STP?**

A As it would be during the application years as

well.

**Q Okay, and would the same thing be said for the 02:55PM**

**subsurface numbers in the next column?**

A Generally, yes, but much less dramatically.

**Q Okay. All right. Let's go back to your**

**report, if we can for a moment. You've explained**

**your concern about what Dr. Engel said, but if -- 02:56PM**

176

and his reliance on Dr. Sharpley's article that we

just looked at.

A Correct.

**Q He cited other articles here in his report,**

**did he not? 02:56PM**

A I don't recall which articles he cited. This

is the only one I remember picking up.

**Q Okay. Would you look at those and see if you**

**have any because in your report you haven't made any**

**criticism of his reliance on these other articles. 02:56PM**

A Then I must not have had issue with them.

**Q Okay. Flip the page just one page over in Dr.**

**Engel's report. Is that the same diagram that Dr.**

**Sharpley used in his report?**

A Looks very similar, if it's not identical. 02:57PM

Hang on a second. It looks identical.

**Q Okay. In fact, he referenced Dr. Sharpley's**

**report, didn't he?**

A Yes, he did.

**Q Okay. Do you have any criticism of that? 02:57PM**

A No.

**Q We're done with that for the time being.**

**Based on the fact that you didn't have any problem**

**with Dr. Engel's reliance on the other reports,**

**would it be fair to conclude that you're not going 02:58PM**

177

1 to testify critically against him for having used  
2 those; you're not going to testify there's anything  
3 wrong with what he did with those other reports?

4 A No. Like I said before, my only concern was 02:58PM  
5 using the 5 percent number from Sharpley, which  
6 using that uniformly and ubiquitously across all the  
7 watershed area, and I did go on and talk in my  
8 report about how, you know, I had a conversation  
9 with Dr. Sharpley about where that 5 percent came  
10 from because I didn't quite understand where it came 02:58PM  
11 from either, and he explained to me that -- it's  
12 outlined in my report where it came from and how  
13 it's probably a worst case scenario, but it's used  
14 to kind of put things in relative perspective, one  
15 to another. 02:58PM

16 Q When did you talk to Dr. Sharpley about that?

17 A This past summer. I don't remember the exact  
18 date. Summer of '08 sometime.

19 Q Did he tell you that his 5 percent figure was  
20 wrong? 02:59PM

21 A No, but we discussed -- as outlined in my  
22 report, we discussed where it came from, and a lot  
23 of it was from rainfall simulation studies and small  
24 plot studies with high intensity rainfall events and  
25 edge of plot sample collection, and he said on 02:59PM

178

A Yes, it is.

Q Let's turn over to Page 386 of that in the  
summary and conclusions section.

A Okay.

Q Let's talk for a minute on the second 03:01PM  
paragraph down under that. Sustainable P management  
begins with sound feed decisions, which in the  
poultry industry lies with the integrator rather  
than the individual farmer. Why is that the case?

A Well, my understanding of the integrated 03:01PM  
production of poultry is that the poultry companies  
blend and manufacture and provide the feed, and it's  
not the responsibility or the job of the farmer to  
supply or blend to supply the feed.

Q Okay. Next sentence, phosphorus inputs onto a 03:02PM  
farm should be matched as closely as possible with P  
export as poultry or crop products. Do you agree  
with that?

A Yes. That's the same issue we talked about  
before, that if you perceive there's a problem with 03:02PM  
phosphorus lost from that farm, then you should do  
as close a job you can do to balance imports with  
exports.

Q Okay, and we were talking about earlier on a  
watershed scale, but I read this -- am I correct in 03:02PM

180

1 average it's probably -- it's probably at the high  
2 end of the range, and it probably was a -- I think  
3 the worst case scenario situation, but he didn't  
4 say it was wrong.

5 Q Those rainfall simulation tests that or 02:59PM  
6 studies that Dr. Sharpley talked about, those are  
7 the kind of studies that have been used commonly to  
8 develop phosphorus indices and for other purposes in  
9 your field; right?

10 A That's correct. 03:00PM

11 Q And he's not saying that those are unreliable  
12 or he shouldn't have used them or anything like  
13 that?

14 A No. They're designed and conducted using the  
15 standard protocol, and professionally we agreed on 03:00PM  
16 what the standard protocol would be, and that  
17 protocol is designed to accentuate the extremes of  
18 possible variation and differences. In other words,  
19 it's a very intense assessment, but he didn't do  
20 that. He followed the protocol. 03:00PM

21 Q The article we've been talking about or the  
22 last article of Dr. Sharpley's, Exhibit No. 7,  
23 that's entitled Overcoming the Challenges of  
24 Phosphorus-Based Management in Poultry Farming; is  
25 that right? 03:01PM

179

reading this as a farm scale?

A This is written on a farm scale basis I  
believe.

Q How would a poultry grower do that; how would  
he balance the inputs of phosphorus to his farm with 03:02PM  
the outputs of phosphorus?

A Well, it would be very difficult because he  
doesn't control the inputs. He doesn't control the  
feed that comes in. The farm would have very little  
control. 03:03PM

Q Okay. Skip down two sentences, long-term  
solutions are likely to include development of  
alternative uses for manure and litter. Is that  
something you agree with?

A In long-term in the case that if it's a 03:03PM  
documented problem on a specific location where you  
have phosphorus loss concerns and you can't get that  
individual property into balance, then they may have  
to look at alternative uses for the litter, yes.

Q Would that principle hold on the scale of the 03:03PM  
watershed as well?

A I don't think you can extend it to a  
watershed. I think you, again, would have to assess  
site by site within the watershed.

Q Okay. How does a farmer find alternative uses 03:04PM

181

1 **for manure and litter?**  
 2 A The most common way to find alternative uses  
 3 would be to have the litter removed off the farm and  
 4 used as a fertilizer on an adjacent farm or a farm  
 5 down the road that can use it. 03:04PM

6 **Q And would that be a circumstance where, as we**  
 7 **talked about before, you look for the most efficient**  
 8 **and effective use for it?**

9 MR. McDANIEL: Object to the form.

10 A If he can't efficiently and effectively, he 03:04PM  
 11 being the male gendered farmer, cannot use the  
 12 litter efficiently and effectively on his farm, then  
 13 the most effective use might be on a farm down the  
 14 road that does not have litter. Maybe it's just a  
 15 beef ranching operation and they can use it 03:05PM  
 16 effectively there.

17 **Q Is the farmer who owns the poultry houses --**

18 A Uh-huh.

19 **Q -- in the real world, do they go through any**  
 20 **thought process that if they have to leave the farm, 03:05PM**  
 21 **to look for the most efficient or effective place to**  
 22 **put it?**

23 MR. McDANIEL: Object to the form.

24 A I can't speak to their thought process the  
 25 farmer would use, but that is the guidance 03:05PM

182

criteria of that plan are more stringent than the  
 plan of a general farm where litter is being  
 applied. So, for example, the receiving farm --  
 this is the Maryland scenario. The receiving farm  
 for transport of litter is under tighter scrutiny 03:07PM  
 than the farm where it was generated.

**Q Okay, but is the scrutiny so tight that it's**  
**only applied where both nitrogen and phosphorus are**  
**needed?**

A No, it's not. 03:07PM

**Q Is the -- in Maryland is the Maryland**  
**phosphorus site index used for the receiving farm?**

A Yes, it is.

**Q What do you know about receiving farms in the**  
**Oklahoma or in the Illinois River watershed; what 03:07PM**  
**are the requirements for someone to receive litter?**

A The details I don't know intimately. My  
 understanding is they had to be under the nutrient  
 management guidance, which include the 590 guidance  
 or the PI guidance in Arkansas, where receiving. 03:08PM

**Q Do either one of those regimes, either the**  
**Oklahoma 590 or the index in Arkansas, require that**  
**litter be put down only where there's a need for**  
**both nitrogen and phosphorus?**

A Not that I'm aware of. 03:08PM

184

1 recommendations that professional advisors provide  
 2 and give to them.

3 **Q Okay, and when I say that, I'm talking, as we**  
 4 **talk before, Doctor, about the place that needs both**  
 5 **nitrogen and phosphorus. 03:05PM**

6 A Okay.

7 **Q In the real world, does a farmer do that that**  
 8 **you know of?**

9 MR. McDANIEL: Object to the form.

10 A Farmers, who are looking for alternative 03:05PM  
 11 sources to utilize the litter that they cannot  
 12 utilize effectively, typically turn it over to a  
 13 third-party broker in my experience, and then that  
 14 broker goes through his avenues of distributing that  
 15 to his clients. I don't know. At that point I 03:06PM  
 16 agree with you. The farmer probably doesn't think  
 17 of it past whatever deal, whatever transaction deal  
 18 he has with a broker.

19 **Q Okay. Does any of your extension education**  
 20 **that you do in Maryland tell third-party brokers 03:06PM**  
 21 **that they should find places where both phosphorus**  
 22 **and nitrogen are needed?**

23 A The sites where the receiving farmers where  
 24 transported litter is utilized, that litter has to  
 25 be managed under a nutrient management plan, and the 03:06PM

183

**Q Let's go down to the beginning of the next**  
**paragraph in that summary and conclusion column.**  
 Even though there's been a concerted effort to  
 implement remedial measures through voluntary and  
 regulatory means, the long-term challenges of 03:08PM  
 accumulating manure and litter on poultry farms has  
 been and remains difficult to overcome. Do you  
 agree with that statement?

A Yes.

**Q Drop down two more sentences. However, more 03:09PM**  
**research is not the single or final solution. You**  
**better read the whole thing so you got that in**  
**context. You can read it but I'll read it so the**  
**Record has it. The next sentence says, research**  
**that better quantifies the sinks and sources of P as 03:09PM**  
**it is transported through a watershed will help**  
**develop realistic expectations for BMPs. Did I read**  
**that correctly?**

A Yes, you did.

**Q What's a sink and a source of P? 03:09PM**

A A sink is a physical location where phosphorus  
 is, such as taken out of the flow way, taken out of  
 the system, adsorbed to soil adsorbed to iron and  
 aluminum, et cetera. The source is where it's  
 introduced into a flow way. 03:10PM

185

1 Q Okay, and tell me what a BMP is.  
2 A Best management practice.  
3 Q And are those the sort of practices that in  
4 your extension work you try to get farmers to employ  
5 for various reasons on their farms? 03:10PM  
6 A Correct.  
7 Q Okay. Including environmental reasons on  
8 their farms?  
9 A Yes.  
10 Q Okay. Next sentence, however, more research 03:10PM  
11 is not the single or final solution. Many farmers  
12 simply do not have the financial resources to  
13 implement and maintain costly remedial measures. Is  
14 that a true sentence; those two sentences together  
15 are true? 03:10PM  
16 A I think it's very accurate. I think farmers  
17 who are trying to manage their operation are always  
18 trying to balance being as efficient and effective  
19 as they possibly can, utilizing nutrients, the  
20 utmost efficiency from an agronomic view, being as 03:11PM  
21 protective of the environmental resources as they  
22 possibly can, and at the same time they don't have  
23 in those wallets and they can't afford to spend a  
24 lot of money if it's decreasing their bottom line  
25 and it's costing them a lot of money. So they are 03:11PM  
186

1 constantly balancing. They're making trade-offs  
2 between what best management practice can I  
3 implement and what it's going to cost me to  
4 implement that. That's part of their business  
5 decision every day. 03:11PM  
6 Q Let's turn over to the top of 386. Despite  
7 there being a variety of programs to help defray  
8 remedial costs, institutional red tape and  
9 conflicting requirements often limit program  
10 enrollment and hinder widespread adoption. Is that 03:11PM  
11 a true statement?  
12 A The only programs I'm really somewhat familiar  
13 with are the programs in Maryland. I'm not familiar  
14 with what they may be specifically referring to, and  
15 there are people who don't want to participate 03:12PM  
16 simply because it's difficult to fill out the forms  
17 and keep track of all the paperwork and there's red  
18 tape and it's troublesome, so they say forget about  
19 it.  
20 Q Is there enough money in Maryland to help 03:12PM  
21 everybody if they all came and applied at once?  
22 A No.  
23 Q Okay. Let's go down to the conclusion heading  
24 there. Clearly, there are many challenges facing  
25 poultry production to be overcome. These involve 03:12PM  
187

the overall sustainability of poultry operations,  
finding alternative uses for manure and litter,  
moving manure and litter to areas of feed and forage  
production and adoption and maintenance of  
innovative BMPs at farm and watershed scales. 03:12PM  
A Uh-huh.  
Q Let's break that down and talk about that in  
little pieces, if we can. We've talked about the  
challenges. When you talk about overall  
sustainability, what does that mean in the context 03:12PM  
of poultry operations?  
A Sustainability is a really loaded word. It  
implies -- depends on the conversation and who is  
involved. It implies economic sustainability,  
profitability, and what's sustainable for one 03:13PM  
individual is not sustainable in the mind of a  
different farm who is expecting a higher rate of  
return, a higher profit. Sustainability as far as  
nutrient balance on a farm, sustainability regarding  
the relationship of a farm operation and the 03:13PM  
surrounding ecosystem. So really that word is  
really a loaded term. Depends on what type of  
conversation you're having, but all those elements  
are part of being sustainable.  
Q Okay. So it's -- in the context of poultry 03:13PM  
188

operations, it's at least both financial and  
environmental; those are two of the factors of  
sustainability?  
A Those are two of probably several factors,  
right. 03:14PM  
Q Okay. Finding alternative uses for manure and  
litter, I guess we talked about that before. The  
farmers try to -- if they can't use it on site, they  
try to move it off site --  
A Correct. 03:14PM  
Q -- and give it to a broker or whatever?  
Moving manure and litter to areas of feed and forage  
production, what does that mean?  
A I interpret that to mean exactly the point you  
brought up earlier today, where if you're growing 03:14PM  
grain -- to use your example, I think you said Iowa  
before. If you're growing grain in Iowa, should the  
litter -- they are proposing that if you're -- let  
me make sure I'm reading right -- moving manure and  
litter to areas of feed and forage production. 03:14PM  
Well, they're saying moving that manure and litter  
to where the grain came from or growing -- the  
converse of that is growing grain locally where the  
litter is generated.  
Q Okay.  
189

1 A So you can look at it either of two ways.  
2 **Q What would be the advantage of moving the**  
3 **litter to where the grain comes from in our example,**  
4 **Iowa?**  
5 MR. McDANIEL: Object to the form. 03:15PM  
6 A In an ideal world, the phosphorus -- on a  
7 phosphorus basis, the phosphorus would be returned  
8 to the place from where it left the field when the  
9 grain was produced, but yet there was phosphorus  
10 introduced to the fields in Iowa that was mined in 03:15PM  
11 central Florida from prehistoric deposits. So  
12 ideally we should -- if you're going to follow that  
13 train all the way back, you have to go back to where  
14 the rock phosphate was mined and recreate historic  
15 deposits, which you can't do reversing geology. So 03:15PM  
16 it makes sense in an ideal world to move it back to  
17 where it came from, but to take the next step to  
18 move back to geologic formation where it was mined  
19 originally is kind of hard to fathom.  
20 **Q Well, if it were moved back to Iowa where the** 03:15PM  
21 **corn is growing --**  
22 A Right.  
23 **Q -- then the corn farmers in Iowa wouldn't have**  
24 **to be getting the rock phosphate from Florida?**  
25 A If enough was moved back, yes. 03:16PM  
190

1 **Q If enough was moved back?**  
2 A Yes, sir.  
3 **Q And so basically the phosphorus would end up**  
4 **being recycled through the corn and the chickens**  
5 **back to the corn?** 03:16PM  
6 A In an ideal world, that could work.  
7 **Q And they're at least mentioning that here?**  
8 A Correct.  
9 **Q Okay, and adoption and maintenance of**  
10 **innovative BMPs at farm and watershed scales.** 03:16PM  
11 **That's what you talked about before?**  
12 A Correct.  
13 **Q Next paragraph down, at some stage the**  
14 **capacity of watersheds to assimilate nutrients**  
15 **assuming some sort of transport of manure from P** 03:16PM  
16 **rich to P deficient areas should be determined and**  
17 **used as strategic planning of future development,**  
18 **expansion or realignment of poultry operations.**  
19 **What's that mean?**  
20 A This is really getting beyond my area of 03:17PM  
21 understanding, but I think they're talking about if  
22 poultry production regions were purposely moved from  
23 existing regions to other regions in the United  
24 States or worldwide or if expansion of production  
25 was purposely targeted for regions, different 03:17PM  
191

regions in the United States or worldwide where  
they're not producing now, then that is really  
something that is more like the theory of about how  
the industry is operating, which I shouldn't even  
speak to. 03:17PM  
**Q Okay. Bottom paragraph in that column, can**  
**the transport of manure -- this is a rhetorical**  
**question or maybe not. Can the transport of manure**  
**within and among watersheds be encouraged to fully**  
**utilize this valuable P resource. The adoption of** 03:17PM  
**manure hauling that links producers with buyers will**  
**greatly enhance the sustainability of poultry**  
**operations over a larger geographic area. What does**  
**that mean?**  
A I think, once again, it's referring back to 03:18PM  
transporting litter from the location of production  
to a different area where they're not being produced  
and that may -- and being able to use it on a farm  
where there is no poultry production going on, and  
that may enhance the sustainability of that 03:18PM  
operation, of the poultry operation.  
**Q And that would be even among watersheds**  
**according to this; right?**  
A According to this, yes.  
**Q Okay. Next column, second sentence -- first** 03:18PM  
192

paragraph, second sentence, as with all confined  
animal feeding operations, sustainability of poultry  
operations hinges on reducing the P imbalances --  
imbalance at farm and watershed scales through  
carefully managed feeding strategies. How do you do 03:19PM  
that at a watershed scale?  
A I don't know.  
**Q Can a farmer, individual farmer do that?**  
A My understanding is individual farmers have  
very little control over their feed. 03:19PM  
**Q Last paragraph in that section, however, the**  
**bottom line is still who will pay to adopt costly**  
**new strategies? Should the public who wants cheap**  
**produce and clean water? Do you have any proposal**  
**that the public should pay for this?** 03:19PM  
MR. McDANIEL: Object to the form. It's  
outside the scope of the opinions he's offered in  
his report.  
A Well, that's really a public policy question.  
I may -- I'll give you an example earlier in the 03:19PM  
state of Maryland that in that -- in Maryland there  
was a public policy decision made that the State's  
Department of Agriculture was going to subsidize  
that, and that's a political policy governing  
decision that I really -- I'm not aware of. 03:20PM  
193

1 **Q Next question, should the integrators who are**  
2 **meeting a market demand and profitability margins,**  
3 **in your view, is there any role for the integrators**  
4 **to help pay for this?**

5 MR. McDANIEL: Same objection. 03:20PM

6 A And the same example. The one example I'm  
7 familiar with, the integrators are playing a role.

8 **Q Should they play a bigger role?**

9 MR. McDANIEL: Objection, same objection.  
10 It's outside the scope of opinions offered in his 03:20PM  
11 report.

12 A I don't know what role they're playing now  
13 quantitatively, so I don't know if it's big or  
14 small.

15 MR. NANCE: Let's go ahead and break. 03:20PM

16 MR. McDANIEL: Just a second before you go  
17 off. Are you through with this exhibit?

18 MR. NANCE: I think so.

19 MR. McDANIEL: Okay. Well, then I just  
20 want to put an objection on the Record under the 03:21PM  
21 rule of completeness with regard to the sections of  
22 the authors' discussion that you omitted from the  
23 examination.

24 MR. NANCE: Okay.

25 VIDEOGRAPHER: We are now off the Record. 03:21PM  
194

concentration. Okay? Then Dr. Johnson took that  
factor and applied it to data from the IRW. Okay?  
My overriding point is that there is, this, again,  
site-by-site variation out there, site-specific  
differences where runoff may -- runoff water may or 03:37PM  
may not be generated and that if runoff water is  
generated, it may or may not reach a receiving body,  
body of water. So I thought it was just a much too  
gross over application, an application of the  
coefficient that Dr. Vadas came up with for a 03:37PM  
different purpose.

**Q Okay. Are you satisfied with the correctness**  
**of what Dr. Vadas did?**

A For the purposes of why he developed it, I  
think it probably was adequate, yeah. 03:38PM

**Q Okay. I happen to have a copy of that report,**  
**as you might imagine. I've marked it as Exhibit 8.**

A Okay.

**Q And is that the paper that Dr. Vadas wrote**  
**that both you and Dr. Johnson are talking about?** 03:38PM

A I believe it is, yes.

**Q Okay. Let's look at the abstract of Dr.**  
**Vadas' paper there on the first page.**

A Uh-huh.

**Q Down at the bottom about half a dozen lines up** 03:39PM  
196

1 The time is 3:22 p.m.

2 (Following a short recess at 3:22 p.m.,  
3 proceedings continued on the Record at 3:36 p.m.)

4 VIDEOGRAPHER: We are back on the Record.

5 The time is 3:36 p.m. 03:35PM

6 **Q Dr. Coale, let's go back for a moment to your**  
7 **report on Page 10, Paragraph 7B.**

8 A Uh-huh.

9 **Q In that paragraph, you take exception to**  
10 **something that Dr. Johnson did, and if you could** 03:35PM  
11 **just explain to me, please, in simplest terms**  
12 **possible, what is your exception to what Dr. Johnson**  
13 **did?**

14 A What -- the work that Dr. Johnson cited was  
15 the work of Dr. Vadas, and Dr. Vadas developed -- 03:36PM  
16 for the purpose of developing large-scale models, he  
17 had to come up with -- see if he could come up with  
18 a single coefficient that related soil test P to  
19 soil soluble P and, therefore, P in runoff, and he  
20 looked over many, many publications and datasets and 03:36PM  
21 put them all together, and in his paper he said that  
22 for the purpose -- in Vadas' paper, for the purposes  
23 of employing this in prediction models, that we  
24 would use a conversion factor, single conversion  
25 factor to relate soil test P to runoff P 03:37PM

195

**he says, overall, a single extraction coefficient,**  
**2.0 for Mehlich III phosphorus data --**

A Uh-huh.

**Q -- 11.2 for water extractable phosphorus data**  
**and a split line relationship for P sorption** 03:39PM  
**saturation data could be used in water quality**  
**models to approximate dissolved P released from soil**  
**to runoff for the majority of soil, hydrologic or**  
**management conditions.**

A Uh-huh. 03:39PM

**Q As far as that sentence goes, are you**  
**satisfied that Dr. Vadas got it right?**

A I wouldn't question -- he's a very good model  
developer, and I think the point to remember there  
is saying that to be used in water quality models. 03:40PM  
That was the intent of this, and when you are  
developing a model -- again, I said previously I'm  
not a modeler, but modelers are always asking people  
like me to help them develop a coefficient because  
they have to have some basis for deciding whether 20 03:40PM  
percent of this goes into this pot or 13 goes in  
that pot or 40 percent goes in that pot when they  
partition things out in a model, and they often  
don't have that data. So they're often trying to  
develop these partitioning coefficients, which is 03:40PM

197



1	exactly what this is. So it's for the purpose of			<b>abstract --</b>	
2	running these models.			A Right.	
3	<b>Q So since we've been talking Mehlich III --</b>			<b>Q -- for Mehlich III?</b>	
4	A Right.			A Right.	
5	<b>Q -- let me just understand what Vadas said</b>	03:41PM		<b>Q And there are other coefficients for other</b>	03:43PM
6	<b>within the scope of his own work.</b>			<b>tests; right?</b>	
7	A Okay.			A Yes, you're right. That's just looking at one	
8	<b>Q This single extraction coefficient, and it's 2</b>			component of a model that has I don't know how	
9	<b>for Mehlich III data; right?</b>			many -- would have a wide variety of components.	
10	A Well, that's what it says in the summary.	03:41PM		That is the coefficient that relates two factors in	03:44PM
11	<b>Q Right.</b>			one component of the model.	
12	A But I think if you look -- it's a linear			<b>Q Let me understand and, again, I know we're</b>	
13	regression equation. You have to look deeper down			<b>talking very broad brush here.</b>	
14	in here for what the full relationship is if you are			A Okay.	
15	going to try to use it with data points from real	03:41PM		<b>Q The two times parts per million equals parts</b>	03:44PM
16	sites.			<b>per billion --</b>	
17	<b>Q Okay. Well, explain to me where in the</b>			A Correct.	
18	<b>article I would look to see that.</b>			<b>Q -- is where; at the edge of the field for</b>	
19	A Well, I came up on this from Dr. Johnson's			<b>purposes of the model, as water is running off the</b>	
20	report, and in Dr. Johnson's report he pulled a	03:41PM		<b>field and it crosses over, is that --</b>	03:44PM
21	linear regression relationship from Vadas' work to			A For purposes of this model, I don't recall.	
22	come up with the conversion, and if I recall			<b>Q Okay.</b>	
23	correctly, it was the regression as represented in			A Honestly I don't. I'd have to go back and	
24	Page 576, Figure 3. The regression equation that's			read that section over again, but it's -- wait a	
25	in the bottom right-hand corner of that box of	03:42PM		minute. Since it's based on -- I can't say. It's	03:44PM
	198			200	
1	Figure 3 --			based on a whole collection of data and most -- and	
2	<b>Q Uh-huh.</b>			I'll make the generalization that most of that data	
3	A -- I believe that's the equation that Dr.			is edge of plot, edge of field type data, so you	
4	Johnson utilized that was in Johnson's report.			can't -- it's not a delivery coefficient to a creek	
5	<b>Q Okay.</b>	03:42PM		or a stream or a lake or what have you, but it would	03:45PM
6	A And that's -- and if you take a broad view for			be a relationship between an STP in the soil and	
7	a model application, they may truncate that equation			runoff -- if runoff was generated from that site,	
8	just to say for modeling purposes let's just call it			what the soluble P in the runoff would be at the	
9	two times because it's a very broad brush.			site.	
10	<b>Q At a very broad brush level, two times what</b>	03:42PM		<b>Q Well, that's what I thought.</b>	03:45PM
11	<b>equals what?</b>			A That's what I think, too, but I -- honestly,	
12	A It was two times -- let me look back at the			this is a little dense for me as far as -- there's a	
13	units. Two times Mehlich III soil test P in			lot of modeling data and a lot of summaries and	
14	milligrams per kilogram in a broad brush equals			calculations in here that you have to pick out what	
15	runoff reactive phosphorus.	03:43PM		is the applied part of it.	03:45PM
16	<b>Q In what unit?</b>			<b>Q Okay. So we've talked earlier about what may</b>	
17	A Micrograms per liter.			<b>happen to runoff after it leaves a field. Various</b>	
18	<b>Q Okay. Two times milligrams per liter?</b>			<b>things may happen?</b>	
19	A No. Two times parts per million.			A Correct.	
20	<b>Q Okay. Two times parts per million?</b>	03:43PM		<b>Q But am I hearing you correctly that Vadas says</b>	03:45PM
21	A Milligrams per kilogram.			<b>at the edge of the field, as it leaves to go on its</b>	
22	<b>Q Okay. Equals --</b>			<b>way whenever it's going, this two times parts per</b>	
23	A Micrograms per liter.			<b>million equals the parts per billion is a broad</b>	
24	<b>Q Okay. That's the -- that's the single</b>			<b>brush coefficient?</b>	
25	<b>extraction coefficient that he talks about in his</b>	03:43PM		A I think if -- I think the brush is a little	03:46PM
	199			201	

1 broader than that. I think it's -- the broad brush  
2 coefficient is saying that at that point in space  
3 where that soil sample is analyzed, and then you can  
4 say if runoff is entered at that point in space, was  
5 the center of the field, the edge of the field or 03:46PM  
6 where it may be. At that point in space, you could  
7 use this broad brush to X coefficient to predict  
8 what the runoff P concentration may be at that site.  
9 It's a very general conversion.

10 **Q But, I assume, helpful in the modeling 03:46PM**  
11 **business?**

12 A I hope so because it sure is hard to get.  
13 Yeah, I assume it is, too.

14 **Q All right. Let's look just for a moment at**  
15 **578. In the conclusions column there on the 03:47PM**  
16 **right-hand side --**

17 A Uh-huh.

18 **Q -- about halfway down that first long**  
19 **paragraph, a sentence begins therefore. Therefore**  
20 **the agronomic Mehlich III and Bray 1, do you see 03:47PM**  
21 **that, Doctor?**

22 A Yes, yes.

23 **Q And Bray 1 soils tests are equally, if not**  
24 **more effective, for evaluating potential for soils**  
25 **to release dissolved P to runoff as the 03:48PM**

202

with the coefficient to be used in modeling, and  
those coefficients are always very rough and very  
approximating, and they're saying, well, they think  
they have a coefficient here that can be utilized  
for the purpose of modeling. I would -- and I don't 03:49PM  
recall them saying and I don't see it reading here.  
I would suspect that they would caution against  
applying it to real world data on a  
data-point-by-data-point basis using a conversion  
because I think they said it over and over again. 03:50PM  
It's for the purpose of developing these broad  
watershed models.

**Q Is accuracy important for developing broad**  
**watershed models?**

A Well, you -- again, I'm not a modeler. You 03:50PM  
want them to be as accurate as possible, but they  
are very gross approximations, which are very  
difficult to precisely partake on a particular site.  
So they're not accurate. It's -- it's as accurate  
as they can be but they're not very accurate. 03:50PM

**Q And Vadas and his co-authors crunched data**  
**from seventeen states; right?**

A They looked at a lot of work.

**Q Had plenty of data to work with?**

A Right. 03:50PM

204

1 environmentally oriented water extraction test.  
2 What does that mean?

3 A I don't know what that means.

4 **Q Okay.**

5 A I don't recall reading it before. 03:48PM

6 **Q Let's go down into the next sentence or the**  
7 **next paragraph, sir. The final paragraph of the**  
8 **conclusions section, just above midway there, there**  
9 **is a sentence that begins the assumption that P**  
10 **extraction coefficients; do you see that? 03:48PM**

11 A Yes.

12 **Q Okay. The assumption that P extraction**  
13 **coefficients are specific to soil types, runoff**  
14 **conditions or management practices implies greater**  
15 **complexity for modeling, but we have shown that a 03:48PM**  
16 **single value for an extraction coefficient relating**  
17 **soil P to dissolved P in runoff can be used across a**  
18 **wide range of soil hydrology for management**  
19 **scenarios.**

20 A Uh-huh. 03:49PM

21 **Q Are the authors of this study, Vadas,**  
22 **Kleinman, Sharpley and Turner, telling us that it's**  
23 **simpler than we used to think it was?**

24 A No. They're saying that -- they're giving  
25 what their purpose is. Their purpose is to come up 03:49PM

203

**Q Okay. Do you have any disagreement with the**  
**sentence I read, and if I need to read it again, I**  
**will, with the one about the assumption that P**  
**extraction coefficients are specific to soil types,**  
**runoff conditions or management practices implies 03:51PM**  
**greater complexity for modeling, but we have shown a**  
**single value for an extraction coefficient relating**  
**to soil P to dissolved P in runoff can be used**  
**across a wide range of soil hydrology or management**  
**scenarios. Are they wrong? 03:51PM**

A No. I'm saying for the purpose of developing  
their models, they are probably fine.

**Q Okay. Last sentence in the article, thus,**  
**predicting dissolved P loss from soil to runoff can**  
**apparently remain simple without sacrificing model 03:51PM**  
**accuracy. Do you disagree with that?**

A It's, in my mind, a reiteration of what we  
just talked about. Their goal was to reduce the  
complexity so, yes, it makes it simple, and in their  
-- their modeling expertise, saying it didn't 03:51PM  
sacrifice accuracy of the model.

**Q So it can be simple and accurate?**

A For these modeling purposes.

**Q Okay. Let's look at your report, Section 7C**  
**at the bottom of Page 10. 03:52PM**

205

1 A Okay.

2 Q Now he's talking about something that he's

3 talked about earlier and the math that Dr. Johnson

4 used.

5 A Uh-huh. 03:52PM

6 Q We may have to get his report to fully

7 understand this. I just want to make sure we get

8 the math right here, and if we want to make this an

9 exhibit, we can, but I'll just show you this. This

10 is I think 10C, the paragraph you were talking 03:53PM

11 about; right?

12 A From Dr. Johnson's report?

13 Q Yeah, this is Dr. Johnson's report. Let's

14 back up and look at 10B because I think that gives

15 us a number we need to use. He says, the average 03:53PM

16 STP value was 38 pounds per acre from forage land

17 sampled, and I'm not asking you to agree with that

18 figure, but I'm just telling you that's what he

19 started with, and you can read and satisfy yourself

20 that that's what he said. 03:54PM

21 A Okay. I understand that.

22 Q Okay. Now, again, in Oklahoma if we're

23 talking 38 pounds per acre, we would do it

24 backwards. We'd divide by two to gets to parts per

25 million? 03:54PM

206

1 A Correct.

2 Q And that would be 19?

3 A Correct.

4 Q So that math is correct; right?

5 A Yes. 03:54PM

6 Q Okay. Let me get where I can -- then he talks

7 about Vadas, and he goes down here, using the

8 prediction equation from this publication, two times

9 parts per million STP equals parts per billion

10 runoff? 03:54PM

11 A Right. He gives -- that's the prediction

12 equation right there.

13 Q Okay, all right. We're going to get there in

14 just a moment. This is the broad brush up here, the

15 two times parts per million equals parts per 03:54PM

16 billion?

17 A Right.

18 Q Okay. So broad brush, using that, if we're

19 plugging in this figure up here, 19 parts per

20 million, what would we get as our parts per billion? 03:55PM

21 MR. McDANIEL: You're asking him based upon

22 the chart in Dr. Johnson's report?

23 MR. NANCE: I'm just asking him based upon

24 the arithmetic and the two times coefficient.

25 A I don't believe the point I made in my report 03:55PM

207

had anything to do with this 19 parts per million in

B.

Q Okay. Why didn't it?

A Well, let me go back and read the report.

Q Okay. 03:56PM

A If you -- I think my -- the point I was making

was pertinent to Paragraph C, where if the runoff P

was .038 parts per million, which is the same as 38

parts per billion, and you substitute that for Y and

do the algebra and X, which is the soil test P in 03:57PM

parts per million, would come out to Mehlich III.

Q .038 parts per million --

A Correct.

Q -- would be what in parts per billion?

A 38. 03:58PM

Q So let's do it broad brush and then let's do

this this way. We're going to do it two ways.

Okay?

A Okay.

Q If we're starting out with 19 parts per 03:58PM

million --

A That's not where I started. I started using

this -- what I referenced was this paragraph under

Paragraph C --

Q Uh-huh. 03:58PM

208

A -- using the data presented there. That's

what I had the exception with.

Q Okay. Well, here's the calculation I'd like

to do right now in realtime.

A Okay. Go ahead. 03:58PM

Q Because he's talking here in C about counties

with less than a thousand tons, and that's what he's

talking about up here in B.

A Okay.

Q Same figure. Up here he tells you, and I'm 03:59PM

not asking you to agree with the accuracy of these

numbers. I just want to make sure we get the math

right.

A Okay. 19 parts per million soil test P.

Q Right. Using the Vadas broad brush equation, 03:59PM

the two -- the single extraction coefficient times

two --

A Which is this equation here.

Q We'll talk about that in a minute. Just a

simple two, two times 19 parts per million would be? 03:59PM

A 38.

Q 38 parts per billion, and is that the same as

.038 parts per million?

A Yes, it is.

Q Okay. So using the broad brush equation, 03:59PM

209

1	that's what you get; right?			there in that text above the graph?		
2	A Right, if you take the Y intercept factor out			A In the text, yes, two times use the broad		
3	of this regression equation that he presented here.			brush in the text.		
4	<b>Q Right, and if -- do you understand what he</b>			<b>Q Okay.</b>		
5	<b>did?</b> 04:00PM			A And then presented the other more precise	04:02PM	
6	A I understand that he took the broad brush that			equation in the figure.		
7	was presented in this abstract of this paper and			<b>Q Okay. So for using the broad brush, he got</b>		
8	used that, but then, as I said a couple of times			<b>the math right?</b>		
9	now, the problem I had with it was presenting this			A Yes.		
10	regression equation and then talking about it when	04:00PM		<b>Q Okay, but he could have used a more precise</b>	04:02PM	
11	the math didn't add up, didn't make sense.			<b>version and gotten a different number?</b>		
12	<b>Q Okay.</b>			A Yes.		
13	A He never mentioned about the broad brush			<b>Q Okay.</b>		
14	approach versus the specific approach. He gave a			A And ignored the precision in the process.		
15	very specific equation that I couldn't match the	04:00PM		<b>Q I understand that's your opinion.</b>	04:02PM	
16	math. That's why I had a problem.			A Okay.		
17	<b>Q Well, but, Dr. Coale, he referenced the broad</b>			<b>Q Now, in 7E, which is on Page 11, you talk</b>		
18	<b>brush right there.</b>			<b>about a conversation you had with Dr. Vadas.</b>		
19	A Where?			A Yes.		
20	<b>Q Using the prediction equation from the</b> 04:00PM			<b>Q Tell me about that conversation, please.</b>	04:03PM	
21	<b>publication, parentheses, two times PPM, underlined,</b>			A Dr. Vadas and I both attended the SERA-17		
22	<b>STP, equals PPB, underline, runoff P. That's the</b>			meeting last summer, and that was immediately		
23	<b>broad brush right there, isn't it?</b>			following when I received this information from Dr.		
24	A But this is the real equation.			Johnson's report. So I took that opportunity to run		
25	MR. McDANIEL: Be specific about what this	04:00PM		the paragraphs where Dr. Johnson referenced Dr.	04:03PM	
	210			212		
1	is when you gentlemen are pointing.			Vadas' work to get the first level off his opinion		
2	A Oh. I'm referring to in Dr. Johnson's report			of whether it had been properly interpreted.		
3	in paragraph -- Subparagraph C on Page 19 that			<b>Q And what was said between the two of you?</b>		
4	there's a graph, there's a figure that shows			A Well, I think the pertinent parts of what was		
5	relationship between Mehlich III STP and runoff P	04:01PM		said was -- I've laid out in my report, and he said	04:03PM	
6	and micrograms per liter.			that basically he thinks that Dr. Johnson		
7	<b>Q All right.</b>			interpreted properly, didn't make any errors		
8	A And there's a single linear relationship shown			interpreting that conversion equation, but he		
9	with an equation describing that relationship, and			thought that the application of that interpretation		
10	that's the equation I used in my calculations where	04:01PM		to real life data and real scenarios in the field	04:04PM	
11	I couldn't understand where he got his numbers from.			was over simplistic.		
12	<b>Q Okay.</b>			<b>Q Okay. What did you give Dr. Vadas for him to</b>		
13	A Now, back to the broad brush approach you were			<b>look at?</b>		
14	talking about, that truncates his equation, makes it			A I gave him -- there in Subparagraph E, I put		
15	less precise and just makes it more in line with a	04:01PM		where I showed Section 10C, 10D and 10E from Dr.	04:04PM	
16	more general overview of the modeling approach that			Vadas' report, and I didn't tell him where it was		
17	was taken. The exception I had -- this is a much			from. I just cut them out and showed them to him.		
18	more precise conversion. So if you're going apply			<b>Q Okay. Towards the bottom of 10E in your</b>		
19	this conversion from specific data from the specific			<b>report --</b>		
20	watershed from a specific soil test, you should use	04:01PM		MR. McDANIEL: 6E?	04:05PM	
21	the most precise conversion equation that you have			MR. NANCE: Excuse me. 6E, you are		
22	available.			correct.		
23	<b>Q I understand that's your testimony and belief.</b>			<b>Q It says about six lines from the bottom, Dr.</b>		
24	<b>But you told me a minute ago he didn't use the broad</b>			<b>Vadas concluded that Dr. Johnson utilized Dr. Vadas'</b>		
25	<b>brush, and he did, didn't he, because it's right</b> 04:02PM			<b>published research in an attempt to demonstrate that</b>	04:05PM	
	211			213		

1 if one applied P to a soil, STP level will increase  
 2 and predict soil soluble P concentrations will also  
 3 increase. Speaking on behalf of the scientific  
 4 consensus, Dr. Vadas stated, we all know that.  
 5 A Right.  
 6 Q Do you all know that in your branch of  
 7 science?  
 8 A I would call that common knowledge, yes.  
 9 Q Everybody knows that?  
 10 A I won't say every individual but, yes, the 04:06PM  
 11 consensus would be that's true.  
 12 Q And that would be an indisputable conclusion  
 13 in your scientific field?  
 14 A We would expect that to be true.  
 15 Q Okay. Let me show you what I've marked as 04:06PM  
 16 Exhibit No. 9. Do you recognize that as an E-mail  
 17 from your considered materials?  
 18 A Yes.  
 19 Q And is this Dr. Vadas' answer basically to  
 20 your inquiry? 04:06PM  
 21 A Yes.  
 22 Q Okay. I'd like you to explain to me, if you  
 23 can, what the next to the last paragraph means,  
 24 finally, this whole analysis ignores the  
 25 contribution of manure itself to DRP loss in runoff. 04:07PM  
 214

1 It implies that STP is controlling runoff DRP, but  
 2 that is a whole other can of worms better left  
 3 unopened. What are the worms in that can, Doctor?  
 4 A He is saying that this is the relationship  
 5 between an STP and dissolved P in runoff, okay, 04:07PM  
 6 without the complicating factor that if you have a  
 7 freshly applied manure application, that that  
 8 relationship falls apart and is controlled by the  
 9 solubility and that quantity of the soluble P in the  
 10 manure that's applied. 04:08PM  
 11 So if you try to take all that into  
 12 consideration, it becomes too complex, and that's  
 13 not what it refers to. It refers to just the  
 14 relationship between soil test P and this predicted  
 15 dissolved P concentration, absent a recently applied 04:08PM  
 16 manure application.  
 17 Q Because if there's a recently applied manure  
 18 application and there's runoff, the dissolved P, the  
 19 DRP is a great deal more?  
 20 A Not necessarily more, but it's no longer -- 04:08PM  
 21 the relationship between soil test P and that runoff  
 22 P concentration falls apart.  
 23 Q Well, it is more, though, isn't it?  
 24 A Typically it's more.  
 25 Q If you lay down fresh manure and it rains, are 04:08PM  
 215

there any circumstances where there would be less  
 dissolved phosphorus than before you laid down the  
 manure?  
 A Typically it would be higher.  
 Q Okay, and it would be a lot higher? 04:09PM  
 A I guess it depends on how much manure was put  
 on it and what the site of the P was.  
 Q Okay. Why is that can of worms better left  
 unopened?  
 A My presumption is from that, that if they 04:09PM  
 tried to model that -- they haven't figured out how  
 to do that yet in the modeling world. That  
 relationship between soil test P that his whole  
 paper talks about is without the compounding factor  
 of a freshly applied manure sample -- manure 04:09PM  
 application.  
 Q Isn't there plenty of research that shows the  
 relationship between the dissolved phosphorus in the  
 runoff and the dissolved phosphorus in the litter?  
 A Yes. 04:09PM  
 Q I mean, that's well known; right?  
 A That's shown in the literature, yes.  
 Q And many times?  
 A Right.  
 Q And when litter is put down on land, the 04:09PM  
 216

dissolved phosphorus is, what, an order of magnitude  
 more of what it would be off the same land's STP?  
 A I couldn't venture a guess on what the  
 difference would be, but I think the point Vadas is  
 trying to make here, that in his purposes they are 04:10PM  
 attempting to develop a modeling -- a coefficient to  
 use in his models. That -- he hasn't figured out  
 how to do that yet if there's been a fresh manure  
 applied. They're not up to that level of  
 sophistication. I think that's the whole point  
 behind -- he says we think we know how to do it but  
 we're just looking at the soil test level without a  
 fresh manure application and runoff so we can have  
 an idea what the controlling factors are, but when  
 fresh manure is applied, we've lost that handle on 04:10PM  
 that prediction and we don't know how to do it.  
 That's my interpretation of what is meant by that.  
 Q Modelers generally don't know how to deal with  
 fresh litter application?  
 A I didn't say that. There may be some modelers 04:11PM  
 who are very good at it, but that's my  
 interpretation of what Vadas said to me in his  
 E-mail.  
 Q Well, are there modelers out there that know  
 how to deal with fresh litter application? 04:11PM  
 217

1 A That's beyond what I can speculate on.  
2 **Q Paragraph 7 beginning on Page 11 in your**  
3 **report is -- it's entitled Site-Specific**  
4 **Determination of Risk.**  
5 A Uh-huh. 04:11PM  
6 **Q In fact, this is the second Paragraph 7 in**  
7 **your report; right?**  
8 A I don't know that.  
9 MR. McDANIEL: Yikes.  
10 A Well, that would be my blunder, yes, sir. 04:12PM  
11 **Q Okay.**  
12 MR. McDANIEL: Can we agree on some  
13 designation for purposes of the Record so it won't  
14 be too confusing?  
15 **Q 7 on Page 11?** 04:12PM  
16 A 7-11.  
17 **Q Okay. It has a certain rhyme to it.**  
18 A I've heard it before.  
19 **Q Again, very broad brush, Dr. Coale, what's the**  
20 **point of a phosphorus index?** 04:12PM  
21 A Broad brush of a phosphorus index is a tool  
22 used in the nutrient management planning process to  
23 look at projected management decisions being made on  
24 the farm and to decide whether those management  
25 decisions were resolved in a relatively low, 04:12PM  
218

1 relatively medium, relatively high, very high risk  
2 for phosphorus loss from that piece of land.  
3 **Q Is a phosphorus index always used at the farm**  
4 **level?**  
5 A No. It's designed to be used at the field 04:13PM  
6 level.  
7 **Q At the field level. Let's go up from the farm**  
8 **level. Is it designed to be used at a watershed**  
9 **level?**  
10 A No. 04:13PM  
11 **Q Tell me what you mean in the phosphorus index**  
12 **context of a critical source area.**  
13 A A critical source area is a term that's been  
14 coined that represents where you have the  
15 intersection of -- on a particular field, of course, 04:13PM  
16 subfield, you have the intersection of a large  
17 phosphorus source. There's a lot of phosphorus in  
18 the soil, and you have a high transport potential.  
19 So you have both a lot of phosphorus present and a  
20 high potential to transport it off. 04:14PM  
21 **Q Okay, and what does a phosphorus index counsel**  
22 **us to do about a critical source area?**  
23 A What does it counsel us to do about it? Those  
24 are the sites where you would have -- a critical  
25 source area should show up on a phosphorus index 04:14PM  
219

evaluation as a higher risk loss situation, and  
those are the sites where you should focus best  
management practices, et cetera, so that you can  
help reduce that loss.  
Part of a P index is -- I mean, something to 04:14PM  
remember is it's using the planning process, so it's  
a scenario, it's a what if. It's a scenario  
evaluation. So you run the scenario evaluation and  
you say, well, I gave a certain -- it has a certain  
relative risk outcome when you do the assessment, 04:14PM  
and then you go back and say, well, where in my  
assessment did I identify a substantial part of my  
risk for P loss is coming from, and then you go back  
with the farmer and say what management practices  
can be modified, changed, adopted, what have you, to 04:15PM  
help reduce the component of the risk.  
**Q Okay. You say in 7B -- 7-11B at the bottom of**  
**Page 11, that both Oklahoma and Arkansas have**  
**adopted P index evaluation tools?**  
A Right. 04:15PM  
**Q What's the Oklahoma P index evaluation tool?**  
A That's essentially the Code 590 standard.  
**Q Okay, and is it like the phosphorus indices in**  
**other states?**  
A It's -- the premise behind it is similar. 04:15PM  
220

**Q And what's the upper limit for land**  
**application of poultry litter in a nutrient limited**  
**watershed in Oklahoma?**  
A If the STP is greater than 300 I believe, 04:16PM  
there's a no application limit.  
**Q And it's 300 pound per acre in Oklahoma?**  
A I believe that's correct. I believe 590 is  
correct.  
**Q What's the scientific basis behind that?**  
A I don't know. 04:16PM  
**Q Who would know?**  
A NRCS staff in Oklahoma.  
**Q All right. Have you ever seen any scientific**  
**research that supports that?**  
A I don't know how it was derived. 04:16PM  
**Q So you haven't seen any research that supports**  
**it?**  
A No.  
**Q Okay. How does the Arkansas phosphorus index**  
**work?** 04:17PM  
A It similarly assesses risk potential due to a  
number of factors that characterize the source  
material, solubility, rate of application, et  
cetera, et cetera, and a series of characteristics  
that evaluate the transport potential for moving it 04:17PM  
221



1 off landscape would be slope, erosion and those kind  
2 of things.

3 **Q Are you personally familiar with the Arkansas**  
4 **phosphorus index?**

5 A Not intimately, but I've seen it and have an 04:17PM  
6 idea how it's structured.

7 **Q Have you seen it written out or is it in the**  
8 **form of software?**

9 A It's written out. I've not seen the software.

10 **Q Where is it written out? 04:17PM**

11 A A publication by DeLaune I believe where I saw  
12 it.

13 **Q About 2004?**

14 A I don't recall the date, but that might be  
15 approximately right. 04:17PM

16 **Q We've got -- in some of the exhibits we**  
17 **already have, we have an example of a phosphorus**  
18 **index, and that would be in this exhibit. I don't**  
19 **have it by number. Let's find it. G-B-U-R-E-K,**  
20 **pronounce that for me. 04:18PM**

21 A Gburek.

22 **Q Gburek. Looks like 6.**

23 A Okay.

24 **Q Let's turn over to Page 137 of that article.**

25 A Uh-huh. 04:18PM

222

1 **Q Have you seen that Table 4 before?**

2 A I've seen it in this article before.

3 **Q Okay. Is this Table 4 typical of a phosphorus**  
4 **index that might be used around the country?**

5 A This looks like the phosphorus index that was 04:19PM  
6 adopted in Pennsylvania. Now, different states,  
7 regions have developed phosphorus indices which look  
8 a little bit different from one another. They have  
9 a little different structure, little different math,  
10 but the concept behind them are all pretty uniform. 04:19PM

11 **Q Okay.**

12 A So I wouldn't promise, but I think this looks  
13 like the Pennsylvania one, which I have seen once or  
14 twice or three times, not a lot.

15 **Q You would not be surprised to hear that I need 04:19PM**  
16 **a little help understanding this.**

17 A Yeah. This one is confusing.

18 **Q Let's walk through it slowly together, if we**  
19 **could, please.**

20 A Okay.

21 **Q Across the very top, I guess once you get**  
22 **into it, there's something called P loss rating**  
23 **value.**

24 A Uh-huh.

25 **Q Okay. Now, does that refer to the line below 04:20PM**

223

it, none, low, medium, high, very high?

A I assume it does.

**Q Okay. The first line here that has site**  
**transport characteristics, do you see that?**

A Yeah. 04:20PM

**Q In this particular phosphorus index or is that**  
**just a label for the two entries below it?**

A No. It's a label for the three entries below  
it.

**Q Soil erosion, runoff class and return period 04:20PM**  
**distance?**

A Correct.

**Q Okay.**

A Well, wait a minute. Return period  
distances is a separate one. That would be a header 04:20PM  
for soil erosion and runoff class.

**Q Okay. So soil erosion, there are a number of**  
**categories to the right of soil erosion. One is**  
**weight, which is 1.0.**

A Correct. 04:21PM

**Q The first category, the first column after**  
**weight is none where it says not applicable.**

A Uh-huh.

**Q What does that mean?**

A And this is just my interpretation of this as 04:21PM

224

it's printed here, that there is not a situation  
where that would apply.

**Q Would that mean --**

A That no site is going to get a none reading.

**Q Gotcha. I'm with you. So low then is less 04:21PM**  
**than 10 milligrams per hectare?**

A Megagrams right there.

**Q Megagrams?**

A Metric tons.

**Q Metric tons. I guess that would be a bigger 04:21PM**  
**than a milligram, wouldn't it?**

A A whole lot bigger.

**Q 10 metric tons per hectare is low erosion; am**  
**I reading that correctly?**

A Yes. 04:22PM

**Q Medium is 10 to 20 megagrams?**

A Correct.

**Q High is 20 to 30?**

A Correct.

**Q And very high is over 30 metric tons per 04:22PM**  
**hectare?**

A Correct.

**Q Okay. How does a metric ton compare to a --**  
**is it an imperial ton?**

A It's a thousand kilograms. 04:22PM

225

1	Q Okay. A kilogram is about 2.2 pounds?		Q Is -- let me ask it another way. Somewhere is	
2	A Right.		there data that forms a curve that breaks at various	
3	Q How do you arrive at these numerical		places and those breaks are incorporated into this	
4	designations for low, medium, high and very high		tool for runoff?	
5	when it comes to soil erosion? 04:22PM		A I can't answer that. I don't know. 04:25PM	
6	A The weights -- I'm not familiar -- what		Q Just as a general proposition, in the PI	
7	numerical designation are you referring to?		writing business --	
8	Q Well, less than 10, 10 to 20, 20 to 30, over		A Right.	
9	30.		Q -- is there empirically distinguishable points	
10	A Right.		of data that support these categories generally, not 04:26PM	
11	Q Is there some scientific breakpoint before 10		wedded to Pennsylvania but --	
12	and 10 to 20?		A A lot of the distinctions between the	
13	A No. I believe those are just segments of a		categories, low, medium, high, et cetera,	
14	continuum.		categories, are based on either -- a couple of	
15	Q So it's not based on some empirical difference 04:23PM		different scenarios I can think of. One is you have 04:26PM	
16	out there in the real world?		a continuum of response and you say, well, we	
17	A No.		believe, based on professional judgment, whoever	
18	Q Okay. Runoff class, what does negligible mean		made the judgment is that we believe that response	
19	under the none column?		is equally distributed from the minimal to the	
20	A Well, I'd have to go back and look at where -- 04:23PM		maximal point. So you divide it into four equal 04:26PM	
21	I don't think we have all the information here in		sections or five equal sections, whatever it might	
22	this publication. Negligible would be the name of a		be.	
23	runoff class where runoff would be negligible.		Other times there may be a situation where you	
24	Q Okay.		think it is not equally distributed. So like under	
25	A Now, how quantitatively that's calculated, I 04:23PM		that soil erosion, these authors apparently, from my 04:26PM	
	226		228	
1	don't think that's presented yet. You'd have to go		interpretation, decided that there was really	
2	back to -- if this is the Pennsylvania P index,		nothing that -- there was no situations which were	
3	you'd have to go back to that document to figure out		-- should have a zero because there's no such thing	
4	how that was done.		as a zero erosion potential in any site. There's	
5	Q All right. Do you know the scientific basis 04:24PM		always some erosion potential. So they said, well, 04:26PM	
6	between the very low or low category, what that is		we're going to truncate the bottom into that scale	
7	in a numerical quantification of runoff?		off, and it's based on a lot of professional	
8	A It's -- first answer is, no, I don't know what		judgment and a lot of collective knowledge, and	
9	-- how that's calculated, don't know what it means,		sometimes not -- you're not going to find	
10	but it's saying that the run -- the expected runoff 04:24PM		quantitative backing for every decision that's made 04:27PM	
11	-- I would interpret it to mean the expected water		in how these are distributed.	
12	runoff from that site was -- in the first category		Q Okay. In the environmental science field,	
13	would be negligible, they wouldn't expect any, and		what's the numerical unit or the unit of measurement	
14	the next category would be very low or low, and then		you used to measure runoff? I mean, up here it's	
15	it gets relatively higher as you go up the scale, 04:24PM		megagrams per hectare. 04:27PM	
16	the potential for surface runoff water to be		A For erosion.	
17	generated.		Q For erosion?	
18	Q All right. In the science that you do --		A Right.	
19	A Uh-huh.		Q What's the similar unit for -- just in your	
20	Q -- are there scientific breakpoints that are 04:25PM		business for runoff? 04:27PM	
21	associated with very low or low runoff, medium		A Well, it depends on whether you are talking	
22	runoff, high runoff, very high runoff?		about total load of runoff. It would be -- it could	
23	A It's usually a continuum, and then in		be cubic meters per hectare, and that would be the	
24	different applications, they may be segmented into		quantities of water left in a certain area. Okay?	
25	categories to make it more simplistic. 04:25PM		That would be a quantity of water that left. So 04:27PM	
	227		229	

1 that would be one unit. There's different units,  
2 but this is a class. This is a classification  
3 variable. It's not a continuous quantitative  
4 variable. So this is just descriptive, a  
5 descriptive variable of a situation into a category. 04:28PM  
6 There's no units on it.

7 **Q Well, I see that. I was wondering if there**  
8 **were units behind it.**

9 A No.

10 **Q Okay. Return period distance, this one makes** 04:28PM  
11 **my head hurt.**

12 A Mine, too. This is very confusing.

13 **Q We're both going to have Tylenol before we are**  
14 **done here. I mean, I can see the none, low, medium,** 04:28PM  
15 **high and very high categories across the top of that**  
16 **section, and I see they've been assigned numbers.**

17 **What's a greater than ten-year return period?**

18 **That's the first category; right?**

19 A Right.

20 **Q I mean, that's a time period obviously. What** 04:28PM  
21 **does that mean?**

22 A If my recollection is correct and, again, I  
23 don't use this type of data, that a storm event, a  
24 rain event that would generate runoff, expected to  
25 generate runoff would occur -- the frequency would 04:29PM  
230

1 be less -- well, it would be greater than -- the  
2 return period would mean it would happen only once  
3 every ten years or longer. Every tenth year or more  
4 time, you would expect to have rainfall that would  
5 generate runoff. 04:29PM

6 **Q Okay, and in a given area, we call -- a**  
7 **ten-year rain would be --**

8 A Well, you expect to get it every ten years.

9 **Q And you hear the weathermen talking about this**  
10 **is a ten-year rain because we got five inches or six** 04:29PM  
11 **inches; it's some --**

12 A You don't expect to have that but once every  
13 ten years.

14 **Q Right.**

15 A Correct.

16 **Q Underneath ten-year it says, greater than 170**  
17 **meters. What does that mean?**

18 A That's in reference to what we talked about  
19 before with the variable source area, distance from  
20 the stream. 04:30PM

21 **Q Okay.**

22 A It's where they're saying, okay, this  
23 location, you don't expect to have a rainstorm  
24 runoff except once every ten years in a ten-year  
25 storm, and your location is greater than 170 meters 04:30PM  
231

from the water. So you're a long way from water.

**Q So if -- would I have it correctly, if you are**  
**trying to figure the risk of a storm, a big ten-year**  
**storm --**

A Uh-huh. 04:30PM

**Q -- and presumably every storm less than**  
**that --**

A Right.

**Q -- you would move back 170 meters from the**  
**stream?** 04:30PM

A No. I think they're taken together, and this  
is where I'm going to have to profess, I don't  
understand how that's done.

**Q Okay. Because I notice as we just work across**  
**there --** 04:30PM

A Right.

**Q -- if it says less than one year, it's less**  
**than 30 meters at the far right end of that same**  
**line; do you see that?**

A Right, and those are two different 04:31PM  
measurements, a frequent storm event and close to  
the river -- close to the stream.

**Q So the kind of storms you get every year are**  
**more common than ten-year storms?**

A Well, I think the interpretation is and, 04:31PM  
232

again, I'm on the edge of my understanding, is that  
you expect to have a storm that would generate  
runoff every year.

**Q Okay.**

A Less than a year, and your site is within 30 04:31PM  
meters of the stream, and you would be in this  
highest risk category here.

**Q So -- okay. Historically every year you are**  
**going to get a rain of a certain size and it's going**  
**to have runoff within 30 meters of the stream?** 04:31PM

A Well, I think there's two separate factors  
there. I think you're going to -- the storm is  
going to return to that frequency.

**Q Okay.**

A And the site you are trying to evaluate is 04:32PM  
within 30 meters of the stream. I would hope that  
before any conclusion is made about this, whoever is  
interested would go and look at the Pennsylvania  
version because I don't understand it that well, but  
that's my broad view of it. 04:32PM

**Q Okay. Let's go ahead and let him change tape**  
**because we have more to go.**

VIDEOGRAPHER: We're now off the Record.

The time is 4:33 p.m.

(Following a short recess at 4:33 p.m., 04:32PM  
233

1 proceedings continued on the Record at 4:40 p.m.)  
 2 VIDEOGRAPHER: We are back on the Record.  
 3 The time is 4:40 p.m.

4 **Q Dr. Coale, let's return to return period a**  
 5 **moment. It seems as I look at this, the longer 04:39PM**  
 6 **period of time from less than one year to more than**  
 7 **ten years seems to be tied to greater distances**  
 8 **presumably from a stream. Why is that?**

9 A I don't know.

10 **Q Now, in the -- up above those figures, there 04:39PM**  
 11 **are the headers, none, low, medium, high and very**  
 12 **high?**

13 A Uh-huh.

14 **Q And it's again a progression from .2 through**  
 15 **1.0. 04:40PM**

16 A Correct.

17 **Q Do you -- first of all, do you know what the**  
 18 **none, low, high, medium, high and very high means in**  
 19 **the context of return period?**

20 A I think those are relative levels of risk for 04:40PM  
 21 that single evaluation factor.

22 **Q Okay. So something that would happen every**  
 23 **year is riskier to happen than something that**  
 24 **happens every ten years?**

25 A That's my interpretation. 04:40PM

234

1 **Q Okay, all right. Dr. Coale, do you know of**  
 2 **any empirical difference between these events**  
 3 **scientifically that causes this index to organize**  
 4 **return period and distance the way it does?**

5 A No. This is just my -- the way I'm 04:41PM  
 6 interpreting this is that the individuals who  
 7 developed this particular P index felt confident  
 8 because of the data they had on hand to organize it  
 9 this way.

10 **Q Okay. Let me give you a for instance and see 04:41PM**  
 11 **if it's going to apply any of these places because**  
 12 **I'm a very scientifically simple guy.**

13 A Okay.

14 **Q But I know that, as evidenced by the weather**  
 15 **outside today, below 32 degrees Fahrenheit, water 04:42PM**  
 16 **turns solid.**

17 A Uh-huh.

18 **Q And above 212 degrees Fahrenheit, it turns to**  
 19 **a gas.**

20 A Uh-huh. 04:42PM

21 **Q And because of those things that happen in the**  
 22 **real world, we may treat water differently at those**  
 23 **different temperatures.**

24 A Correct.

25 **Q And that's a very simple example, but that's 04:42PM**

235

the best I've got.

A Uh-huh.

**Q Is there any empirical change in any of these**  
**factors that happens that underlies the categories**  
**we see on this phosphorus index? 04:42PM**

A Not that I know of.

**Q Okay. Let's look at site source**  
**characteristics. That's the next thing down, and**  
**like the other things, it's got across the top,**  
**none, low, medium, high and very high, and beneath 04:42PM**  
**each of those headers is associated a number, zero,**  
**one, two, four and eight.**

A Uh-huh.

**Q Do you know the rationale for either the**  
**descriptor headings or the numbers underneath them? 04:43PM**

A Well, I think the descriptor headings are  
 the same we talked about before. They're for those  
 individual elements of risk assessment. Those are  
 the categorical classification going from none,  
 being the lowest on the risk scale, to high being 04:43PM  
 the highest, and I believe that the numbers in  
 parenthesis underneath relate to when you are doing  
 a scoring of a site, that's the numerical value that  
 you would use in the tabulation of the score.

**Q Okay, and I think we'll get to that in a 04:43PM**

236

**minute. The first actual quality under that is soil**  
**test P?**

A Correct.

**Q Or soil P test in this case. And I guess**  
**they're saying not applicable under none; there 04:44PM**  
**can't be no STP?**

A I don't think that's what it means.

**Q Oh, okay.**

A Basically they're saying they're not going to  
 give any site a none rating. 04:44PM

**Q All right, okay. Then low, medium, high and**  
**excessive.**

A Right.

**Q Do you know the numerical values that underlie**  
**those descriptors? 04:44PM**

A Not off the top of my head, but I presume, as  
 we mentioned earlier, they are probably the Penn  
 State University agronomic recommendation categories  
 for fertility.

**Q Okay. If it were Maryland, which is the one 04:44PM**  
**you know because you work with it --**

A Right.

**Q -- do you have similar categories, low,**  
**medium, high or excessive or something like that for**  
**soil test phosphorus? 04:44PM**

237

1 A Yes, we do.  
2 Q What are the numbers that underlie your --  
3 A Well, we have to switch scales.  
4 Q We'll just try to endure it.  
5 A Okay. The low would be zero to 25 FIV, 04:45PM  
6 fertility index value.  
7 Q Zero to 25. I love this. This is going to be  
8 fun.  
9 A It's pretty simple when you get to the end of  
10 it. 04:45PM  
11 Q Okay.  
12 A Low is zero to 25. The medium would be 25 to  
13 50.  
14 Q Okay.  
15 A The next category is called optimum, and it's 04:45PM  
16 50 to 100, and the next category is called  
17 excessive, and that's greater than 100.  
18 Q This is -- tell me what the FIV is again.  
19 A Fertility index value.  
20 Q Okay. Now is when I cash in on your promise 04:45PM  
21 to make this simple.  
22 A For the case of phosphorus, that's equivalent  
23 to parts per million Mehlich III P.  
24 Q All right, and so in Oklahoma your optimum  
25 would be 100 to 200 pounds per acre? 04:46PM  
238

1 MR. McDANIEL: You said Oklahoma, Bob.  
2 MR. NANCE: Well, to convert to what we  
3 think of in Oklahoma.  
4 MR. McDANIEL: Okay. Sorry.  
5 Q You got 50 to a hundred. 04:46PM  
6 A So it would -- if you use the conversion in  
7 Oklahoma, it would be times two, so, yes.  
8 Q Okay, all right.  
9 MR. McDANIEL: You're jumping around the  
10 country. I'm sorry. I was a state or two behind. 04:46PM  
11 MR. NANCE: That's quite all right.  
12 Q Now, in our exhibit here, we have two sets of  
13 two lines. One is P fertilizer application rate and  
14 P fertilizer application method.  
15 A Uh-huh. 04:47PM  
16 Q Then the next two are organic P source  
17 application rate and organic P source applied  
18 method.  
19 A Uh-huh.  
20 Q Let's walk across and figure this out. In the 04:47PM  
21 none, there's none applied. We won't deal with  
22 that. Low for P fertilizer application rate is 1 to  
23 15 kilograms of phosphorus per hectare.  
24 A Okay.  
25 Q And we can see all the rest of the numbers. 04:47PM  
239

Do we know why they have grouped 1 to 15, 16 to 45,  
46 to 75 and over 76?  
A No, I don't.  
Q Okay. Is there any easy conversion of  
kilograms per hectare to any other unit that a human 04:47PM  
being might know?  
A It's -- for general discussion purposes, it  
can be equivalent to pounds per acre.  
Q It's another broad brush rule of thumb kind of  
thing? 04:48PM  
A Yeah, it's close.  
Q All right. Do you recognize, looking at those  
numbers, any ice, water, steam empirical  
relationship that makes them divide them up the way  
they do? 04:48PM  
A No.  
Q Okay. Fertilizer application method, place  
with planter deeper than five centimeters  
incorporated immediately before crop, incorporated  
more than three months before crop or surface 04:48PM  
applied less than three months before crop and  
surface applied more than three months before crop.  
A Uh-huh.  
Q I'm guessing, as I look at that, we're going  
in increasing risk as we go from left to right? 04:49PM  
240

A Correct.  
Q Why is each entry to the right more risky than  
the one to the left of it?  
A For that row?  
Q For that row. 04:49PM  
A Well, if none applied, the risk is zero. If  
it's placed with a planter deeper than five  
centimeters, it means that that phosphorus, that  
fertilizer has been applied as being injected into  
the soil, below the surface of the soil so it's less 04:49PM  
prone for interaction with runoff water.  
Q Okay.  
A The next one is supplied incorporated  
immediately before the crop is planted, so it's  
spread on the surface and then immediately plowed 04:49PM  
in. These are row crop situations.  
Q Okay.  
A Next one is incorporated greater than three  
months before. That means the time it's sitting in  
the field before the crop is growing and utilizing 04:50PM  
it is longer, so the risk for loss is higher, and  
it's been incorporated or if you surface apply it  
and not incorporated less than three months, and  
then the risk -- the highest risk category would be  
the surface applied greater than three months before 04:50PM  
241

1	crop planted.			A	Uh-huh.		
2	<b>Q</b> And that's riskiest because it's subject to			<b>Q</b>	Let me see if I can understand what happens		
3	the elements for over three months?				here. Up above we get an erosion rating.		
4	A Correct.			A	Uh-huh.		
5	<b>Q</b> Before the plants get to it? 04:50PM			<b>Q</b>	That's the very top category we looked at; 04:53PM		
6	A Correct.				right?		
7	<b>Q</b> Okay. The organic source application rate, it			A	Correct.		
8	increases in risk from left to right I assume, but			<b>Q</b>	Below that there's a runoff class rating.		
9	the units are smaller than for P fertilizer			A	Uh-huh.		
10	application rate. Do you see that? 04:50PM			<b>Q</b>	Then there's a return period rating. 04:53PM		
11	A Yes, I do.			A	Right.		
12	<b>Q</b> Do you know why that is?			<b>Q</b>	And there's an asterisk that says note, that		
13	A No, I don't.				waiting for return period is different than that for		
14	<b>Q</b> Is there anything that makes organic				erosion and runoff characteristics. Do you know why		
15	phosphorus riskier than commercial fertilizer 04:51PM				they had to say that? 04:54PM		
16	phosphorus that would justify them using smaller			A	I think maybe the numbers in parenthesis for		
17	units?				those categories are different. Needs to draw		
18	A I don't know what their logic was for using				people's attention to it maybe.		
19	smaller units.			<b>Q</b>	Okay. To get our erosion rating, just		
20	<b>Q</b> Okay. All right, and the application methods 04:51PM				assuming we plugged something in here, if we were in 04:54PM		
21	are a little bit different but I think I understand				that first low category, we lost less than 10 metric		
22	them. Look at the column called weight.				tons per hectare?		
23	A Uh-huh.			A	Uh-huh.		
24	<b>Q</b> Everything gets a 1.0, except fertilizer			<b>Q</b>	Would our erosion class rating be .7?		
25	application rate and fertilizer application method. 04:51PM			A	The way I understand this, yes. 04:54PM		
	242				244		
1	Application rate is .75 and fertilizer application			<b>Q</b>	Okay, and if our runoff class was very low to		
2	method is .5. Do you know why those rates are				low -- very low or low, however you define that, it		
3	assigned -- excuse me, those weights are assigned				would also be .7?		
4	the way they are?			A	I agree.		
5	A My presumption is that the developers -- it's 04:52PM			<b>Q</b>	Okay. Is the return period ratings, are 04:55PM		
6	by a group of people that developed this, their best				those -- is that a dial you can use to decide how		
7	professional judgment on how important that single				conservative or how risky you want to be in terms of		
8	factor is.				your distance allowing -- placement distance from		
9	<b>Q</b> Okay. Is there any established science that				the stream; I mean, is that a policy thing that you		
10	justifies those weight numbers that you know of? 04:52PM				can tune depending on how you want to? 04:55PM		
11	A I don't know what science they used to get			A	That's not the way I understand it. Like I		
12	their adjustments.				said before, I'm really working on my edge of		
13	<b>Q</b> Okay. Do you have weights like this in				understanding of what return period distance, how		
14	Maryland or do you have a weight category in				that's utilized in this model, in this PI.		
15	Maryland? 04:52PM			<b>Q</b>	Okay, but somehow in return period, you're 04:55PM		
16	A A weighted.				going to get a number. It's going to get from none		
17	<b>Q</b> Okay. Why do you weigh things in Maryland the				to very high and it's going to run from .2 to 1.0?		
18	way you do?			A	Correct.		
19	A It began based on best professional judgment			<b>Q</b>	And you're going to multiply erosion times		
20	on which categories you -- which elements of the 04:53PM				runoff times return period? 04:56PM		
21	risk loss assessment tool you think are -- need to			A	Correct.		
22	be more strongly emphasized or de-emphasized in			<b>Q</b>	And then you're going to multiply that product		
23	regard to how they impact the final outcome.				times -- what's the Sigma mean?		
24	<b>Q</b> Okay. Down below all of this there's a line			A	That's the summation.		
25	that says PI equals; do you see that? 04:53PM			<b>Q</b>	Okay. Summation of source characteristic 04:56PM		
	243				245		



1 rating, which is going to be either fertilizer or  
 2 organic; right; it's going to be one or the other of  
 3 those?  
 4 A Well, I think all these are source  
 5 characteristics. There's five different 04:56PM  
 6 characteristics.  
 7 Q Well, I'm looking down the left-hand margin  
 8 and it looks like -- well, three sources, excuse me.  
 9 Soil P test, we about overlooked that.  
 10 A Right. 04:56PM  
 11 Q And then that's going to be what it is --  
 12 A Right.  
 13 Q -- based on a test, and then you're going to  
 14 be applying either -- I assume P fertilizer is  
 15 commercial; is that right? 04:57PM  
 16 A Yes.  
 17 Q Okay. You are going to be applying either  
 18 commercial fertilizer or organic fertilizer?  
 19 A Or both.  
 20 Q Or both. Oh, boy. Okay. Then based on 04:57PM  
 21 either the amount of the commercial fertilizer or  
 22 the organic fertilizer or both, you get a sum of  
 23 what?  
 24 A The way I would work through this bottom half,  
 25 bottom portion of this table, there's five different 04:57PM  
 246

1 rows of assessment characteristics.  
 2 Q Okay.  
 3 A You work across each row independently.  
 4 Q All right.  
 5 A So, for example, like the first row would be 04:57PM  
 6 soil P test.  
 7 Q Okay.  
 8 A And I'd say where is this site in that scheme,  
 9 and if it's medium in that scale, it would have a  
 10 medium score of two. 04:57PM  
 11 Q Okay.  
 12 A Times a weighting factor of one, and then I  
 13 put that off here to the right side. That's  
 14 one-fifth of my answer.  
 15 Q I see.  
 16 A And then I go to the next row and do the same  
 17 thing, and then I would add them all up.  
 18 Q Okay, and multiply each one times its  
 19 respective weight?  
 20 A Right. 04:58PM  
 21 Q Okay, and then you get some phosphorus  
 22 indexing number?  
 23 A Correct.  
 24 Q Multiplying all those things together?  
 25 A Uh-huh. 04:58PM  
 247

Q And a site P loss vulnerability is some sort  
 of qualitative assignment?  
 A Correct.  
 Q From low, medium, high to very high?  
 A Correct. 04:58PM  
 Q Okay. In Maryland your agronomic limit is --  
 you tell me. I'm going to multiply and get it  
 wrong.  
 A Agronomic limit for what?  
 Q For phosphorus. 04:59PM  
 A Okay. The -- it would be -- what's considered  
 the agronomic limit would be 50 FIV, 50 milligrams  
 per kilogram.  
 Q And translating that to Oklahoma 100 pounds  
 per acre? 04:59PM  
 A It would be 100 pounds per acre by the  
 Oklahoma conversion.  
 Q Okay, and you would assign -- that would be  
 the breakpoint between medium and optimum?  
 A Correct. 04:59PM  
 Q In your --  
 A Correct.  
 Q And you say optimum is something even above  
 the agronomic limit?  
 A The category that's titled optimum is between 04:59PM  
 248

50 and 100 on that scale, on the FIV scale.  
 Q If we were using 65 as our agronomic limit,  
 pounds per acre, we can't tell from this chart in  
 the exhibit where that would be, whether it would be  
 low, medium or whatever? 05:00PM  
 A No.  
 Q Okay. Is this the kind of thing that you  
 consider as a phosphorus index is -- as you say on  
 Page 12, 7-11C, it's an easily used field rating  
 system; is what we've gone through something you 05:01PM  
 consider an easily used field rating system?  
 A In my opinion, I think it is, except for the  
 return period distance, which is not included in the  
 Maryland one because I think it's not -- I think  
 that element is not easily used. 05:01PM  
 Q Okay. Is the information here readily  
 available?  
 A Yes.  
 Q Okay. Do you think that's broadly applicable?  
 A As far as I know, yes. 05:02PM  
 Q And instructive?  
 A We've spent a lot of time studying it. Yes,  
 it's instructive.  
 Q Do you spend a lot of time teaching it as  
 well? 05:02PM  
 249

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25  
  
1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25

<p>A Yes.</p> <p><b>Q What phosphorus index should the court use for the Illinois River watershed?</b></p> <p>MR. McDANIEL: Object to the form, calls for a conclusion that's for the court to make. It's outside the scope of his report. 05:02PM</p> <p><b>Q Well, let me ask it this way: Do you have a recommendation that you're going to make to the court about a phosphorus index that should be used in the Illinois River watershed?</b> 05:03PM</p> <p>A Specifically, no, but I think in theory, it should be developed by the people who have the most intimate knowledge of the watershed.</p> <p><b>Q And who are those people?</b></p> <p>A I don't know the individuals. 05:03PM</p> <p><b>Q As between the Oklahoma 590 code and the Arkansas phosphorus index, which is more generous in allowing land application of phosphorus, 590 for the Illinois River watershed?</b></p> <p>A Right. That I don't know. I haven't made that comparison. 05:03PM</p> <p><b>Q Are you going to make that comparison before you testify?</b></p> <p>A I hadn't planned on it.</p> <p>MR. NANCE: Okay. I think that's as good a 05:04PM</p> <p>250</p>	<p>SIGNATURE PAGE</p> <p>I, Frank Coale, PhD, do hereby certify that the foregoing deposition was presented to me by Lisa A. Steinmeyer as a true and correct transcript of the proceedings in the above styled and numbered cause, and I now sign the same as true and correct. WITNESS my hand this _____ day of _____, 2009.</p> <p>FRANK COALE, PhD</p> <p>SUBSCRIBED AND SWORN TO before me this _____ day of _____, 2009.</p> <p>Notary Public</p> <p>My Commission Expires: _____</p> <p>252</p>
<p>place as any to stop for the day.</p> <p>VIDEOGRAPHER: We are now off the Record. The time is 5:05 p.m. (Whereupon, the deposition was recessed at 5:05 p.m.) 05:04PM</p> <p>251</p>	<p>C E R T I F I C A T E</p> <p>STATE OF OKLAHOMA )  ) ss. COUNTY OF TULSA )</p> <p>I, Lisa A. Steinmeyer, Certified Shorthand Reporter within and for Tulsa County, State of Oklahoma, do hereby certify that the above named witness was by me first duly sworn to testify the truth, the whole truth and nothing but the truth in the case aforesaid, and that I reported in stenograph his deposition; that my stenograph notes were thereafter transcribed and reduced to typewritten form under my supervision, as the same appears herein.</p> <p>I further certify that the foregoing 252 pages contain a full, true and correct transcript of the deposition taken at such time and place.</p> <p>I further certify that I am not attorney for or relative to either of said parties, or otherwise interested in the event of said action.</p> <p>WITNESS MY HAND AND SEAL this 19th day of January, 2009.</p> <p>LISA A. STEINMEYER, CRR CSR No. 386</p> <p>253</p>

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25

CORRECTIONS TO THE DEPOSITION OF FRANK COALE, PhD Volume I	
PAGE AND LINE NUMBER	CORRECTION
254	

A		
<b>ability</b> 96:16 105:5,15 <b>able</b> 25:14 32:12 63:16 64:25 192:18 <b>aboveground</b> 65:11 <b>absent</b> 215:15 <b>absolute</b> 50:21 70:18 <b>absolutely</b> 17:24 72:15 104:24,24 149:12 160:21 162:18 <b>absorb</b> 130:1 <b>absorbed</b> 109:12 <b>abstract</b> 196:22 200:1 210:7 <b>academic</b> 120:22 <b>accentuate</b> 179:17 <b>acceptable</b> 114:9 135:9 <b>accepted</b> 110:24 167:1 <b>access</b> 66:10 <b>accomplish</b> 129:18 <b>accounts</b> 157:6 <b>accumulate</b> 65:9 90:4 105:6 111:11 124:14 130:21 <b>accumulated</b> 105:12 126:24 <b>accumulating</b> 105:11 111:16 158:19 185:6 <b>accuracy</b> 204:13 205:16,21 209:11 <b>accurate</b> 109:20 134:17,18 154:22 166:8 168:9 186:16 204:16,19,19,20 205:22 <b>accurately</b> 122:10 <b>Achieving</b> 157:22 <b>acid</b> 56:23,24 57:4 <b>acknowledgement</b> 156:19 <b>acre</b> 90:5,7 101:3,5,13 119:19 120:9 121:7,10 169:13 206:16,23 221:6 238:25 240:8 248:15,16 249:3 <b>acreage</b> 61:25 147:11 <b>acres</b> 100:22 <b>across-the-board</b> 166:1 <b>action</b> 253:21 <b>actions</b> 164:13 <b>active</b> 29:7 123:14,17,22	124:2,9,16,20 <b>actively</b> 97:14 <b>activity</b> 78:5 <b>acts</b> 126:19 <b>actual</b> 153:19 163:16,21 237:1 <b>add</b> 71:20 98:22 114:5 210:11 247:17 <b>added</b> 90:14 119:6,17 129:3 155:10 172:22,23 <b>adding</b> 90:25 110:21 <b>addition</b> 75:24 91:8 <b>additional</b> 119:5 <b>additions</b> 31:17 113:8,18,21 <b>address</b> 157:19 161:22 <b>adequate</b> 63:9 196:15 <b>adjacent</b> 29:7 73:13 123:16 124:23 182:4 <b>adjustments</b> 243:12 <b>adopt</b> 193:12 <b>adopted</b> 139:18 220:15,19 223:6 <b>adoption</b> 12:11 187:10 188:4 191:9 192:10 <b>adsorbed</b> 118:10 126:4 129:9 185:23,23 <b>adsorbs</b> 126:4 <b>adsorption</b> 126:25 129:5 169:5 <b>advances</b> 71:25 <b>advantage</b> 190:2 <b>advisability</b> 49:25 51:12,19 <b>advise</b> 26:12,14,17 27:3 <b>advised</b> 26:21 <b>advises</b> 35:19 <b>advisors</b> 11:13 26:25 56:18 183:1 <b>afford</b> 186:23 <b>aforesaid</b> 253:11 <b>afternoon</b> 106:24 <b>agencies</b> 26:18 <b>agency</b> 11:13,14 53:1 86:11 <b>aggravating</b> 154:8 <b>aggressively</b> 91:14 97:16 <b>ago</b> 22:11 63:4 91:23 154:22	155:3,5,24 211:24 <b>agree</b> 56:19 94:1 153:1 154:20 158:7,25 167:5,19 168:8,24,25 169:7,15 172:2 180:17 181:14 183:16 185:8 206:17 209:11 218:12 245:4 <b>agreed</b> 54:23 56:21 179:15 <b>agricultural</b> 6:13,15,24 7:5 8:22 9:16 11:12 16:4 30:14 31:14 53:15 93:14,20 123:12 <b>agriculture</b> 6:7 7:15 50:17,18 52:21 134:2,9,20 155:18 193:23 <b>agronomic</b> 6:11 33:17 95:12 186:20 202:20 237:18 248:6 248:9,12,24 249:2 <b>agronomically</b> 27:19 33:9 41:3,24 42:15,16 169:10 <b>agronomics</b> 33:16,18 <b>agronomy</b> 156:9 <b>ahead</b> 16:24 21:1,3 24:18 37:21 84:18 123:1 147:18 194:15 209:5 233:21 <b>air</b> 140:1 <b>al</b> 1:11 <b>algae</b> 88:10 135:8 <b>algebra</b> 208:10 <b>alien</b> 21:19 <b>allowing</b> 149:20 245:8 250:18 <b>alternative</b> 29:6 181:13,19,25 182:2 183:10 188:2 189:6 <b>alternatively</b> 148:3,4 <b>aluminum</b> 127:1 129:16 168:5 185:24 <b>amended</b> 128:22 <b>amendment</b> 130:12 <b>amount</b> 20:16 61:15 63:24,25 70:13 113:19 147:11 159:20 168:14,20 246:21 <b>AmSouth</b> 2:23 <b>analyses</b> 163:6 <b>analysis</b> 49:20 214:24 <b>analyzed</b> 19:20 202:3 <b>angle</b> 42:18

**animal** 93:25 102:13,15  
147:5 157:16 193:2  
**animals** 97:18,19,22  
**annual** 153:12 157:12  
**answer** 11:25 21:1 37:2,11  
51:16 53:3 59:7 61:21,24  
66:13,13 67:22 68:3,24  
82:12 83:16 89:6 104:19  
115:25 137:6 157:3,23  
158:7,10 159:17 161:8  
162:17 165:23 214:19 227:8  
228:5 247:14  
**answered** 35:2 40:19 73:3  
81:20 83:12,12 145:21  
**answering** 48:3  
**anticipate** 59:16  
**anybody** 67:7 130:10  
**anyway** 47:2  
**apart** 16:7 215:8,22  
**apparent** 119:12  
**apparently** 205:15 228:25  
**appears** 120:22 148:13  
165:20 168:9 172:21 253:15  
**applicable** 224:22 237:5  
249:19  
**application** 10:25 22:6,14  
24:22 30:10,25 31:1 33:20  
34:5 35:15 63:21 68:20  
75:19 77:16 78:15 79:2  
87:17,23 93:24 94:10  
100:18 110:5 114:7 119:12  
143:12 144:7 145:14,17  
147:3 148:12,19,21 149:21  
160:7 166:5 168:13,19,21  
172:4,14,17,19 175:3,6  
176:8,11,18 196:9,9 199:7  
213:9 215:7,16,18 216:16  
217:13,19,25 221:2,5,23  
239:13,14,17,22 240:17  
242:7,10,20,25,25 243:1,1  
250:18  
**applications** 30:18 63:1,15  
63:18 68:24 106:6 114:23  
116:14 142:24 149:4 154:9  
227:24

**applied** 20:23 21:9 29:21  
30:24 31:19 39:5 63:9,22,25  
66:20 67:12 69:22,24 74:9  
74:23 75:3 82:24,25 83:1  
87:10 90:3 94:6 98:12  
100:15,17 114:21 115:15  
116:10 121:5 128:5 147:12  
160:16 166:2 167:2,7,16  
168:2,14,20 169:14 170:8  
173:20 174:4,9,10 184:3,8  
187:21 196:2 201:15 214:1  
215:7,10,15,17 216:15  
217:9,15 239:17,21 240:21  
240:22 241:6,9,25  
**apply** 10:25 20:11 21:15  
24:12 25:12,21 26:4,6 31:18  
33:11,22,24 34:10,22 35:11  
36:14 44:1 54:19 60:6 61:4  
61:16 64:15,17,20,25 89:13  
89:16 96:12,16 116:15,15  
116:22 127:5 150:13 160:17  
170:13 173:25 174:18  
211:18 225:2 235:11 241:22  
**applying** 20:13,16 22:12  
24:13 34:3 60:15 89:14  
111:10 143:11 144:4,20  
149:25 166:11 174:7 204:8  
246:14,17  
**appreciate** 162:1  
**approach** 210:14,14 211:13  
211:16  
**approached** 8:6,9  
**appropriate** 23:19 24:12,15  
27:19,21 83:14 104:17,23  
140:17 159:1,3 170:9,10  
**appropriateness** 54:3  
**approximate** 197:7  
**approximately** 19:16 101:12  
107:22 139:1 222:15  
**approximating** 204:3  
**approximations** 204:17  
**AR** 2:14,20  
**area** 7:4,5,6 18:5 51:22 71:11  
71:23 81:23 82:8,13,15  
88:14 125:5,8,10,13 143:16

144:8,15,16 147:4 149:19  
149:20 161:17 167:2 178:7  
191:20 192:13,17 219:12,13  
219:22,25 229:24 231:6,19  
**areas** 9:21,22 59:4 137:18  
138:25 143:11 144:4,19,19  
145:8 148:9,13,13 153:5,20  
154:10 160:15 161:12 188:3  
189:12,20 191:16  
**arguing** 82:18  
**argumentative** 44:10 160:10  
**arises** 50:5  
**arithmetic** 207:24  
**Arkansas** 47:6 48:21 59:11  
107:17 161:10 163:10  
184:20,22 220:18 221:19  
222:3 250:17  
**arrive** 156:11 226:3  
**article** 107:4,7,11,15 108:4,6  
108:15,21 111:5 133:22  
153:2 165:18 170:3,3 177:1  
179:21,22 198:18 205:13  
222:24 223:2  
**articles** 117:25 133:14 152:17  
177:4,6,10  
**artificially** 159:20,24 160:12  
**aside** 117:13  
**asked** 8:20 10:14 35:1 40:19  
57:10 73:2,12 81:19 107:14  
131:7 145:21,24 160:4  
**asking** 9:24 24:17 37:20,23  
38:1 48:4 49:21 54:8 61:7  
73:20 74:25 81:14 83:10  
147:21 160:17 197:18  
206:17 207:21,23 209:11  
**asleep** 140:3  
**assess** 9:21 26:5 35:3 36:3,16  
51:25 78:23,24 114:20  
116:21 181:23  
**assessed** 34:19 35:7 42:11  
146:13  
**assesses** 221:21  
**assessment** 35:17,19 36:19  
37:5,13 39:20 40:1 43:12  
44:2 49:17 78:21 116:19,19

<p>117:1 133:8 151:4,5 162:19 179:19 220:10,12 236:18 243:21 247:1 <b>assessments</b> 35:24 36:5 <b>assessor</b> 35:19 <b>assign</b> 248:18 <b>assigned</b> 230:16 243:3,3 <b>assignment</b> 9:25 248:2 <b>assimilate</b> 191:14 <b>associated</b> 116:24 227:21 236:11 <b>Asst</b> 2:6 <b>assume</b> 15:5 24:11,14 35:6 90:18 91:7 156:12 202:10 202:13 224:2 242:8 246:14 <b>assumed</b> 24:17 92:12 119:16 122:5 <b>assumes</b> 112:12 146:16 <b>assuming</b> 42:5 80:23 115:5 117:4 120:8 130:23 191:15 244:20 <b>assumption</b> 19:24 45:15 112:15 115:2 121:5,19 137:17 138:18 203:9,12 205:3 <b>assumptions</b> 122:17 <b>asterisk</b> 244:12 <b>attached</b> 118:11 <b>attempt</b> 213:25 <b>attempting</b> 217:6 <b>attended</b> 11:18,24 212:21 <b>attendees</b> 12:3 <b>attention</b> 79:13 86:25 144:17 244:18 <b>attenuated</b> 125:2 <b>attorney</b> 1:5 2:3,6,9,13,16,19 2:22 253:19 <b>attributed</b> 93:12 <b>audiences</b> 12:2 <b>Austin</b> 8:15,17,19 <b>author</b> 92:22,24 158:2 <b>authors</b> 145:5 146:18,21,22 146:24 148:24 150:10 154:18 169:16 170:23 194:22 203:21 228:25</p>	<p><b>authors's</b> 152:20 <b>author's</b> 107:20 145:2 <b>available</b> 16:5 18:18 19:23 26:1,2,7 28:25 44:13 55:4 68:11 71:17,18,18 72:2 88:6 96:19,20 129:10 149:21 211:22 249:17 <b>avenues</b> 183:14 <b>average</b> 104:22 119:19 179:1 206:15 <b>averaged</b> 103:18 104:16 <b>avoid</b> 144:19 145:14 <b>aware</b> 22:13 31:21 32:4 58:20 59:22 60:11 62:6 64:11 84:1 86:13,18 92:3 102:22 120:19 140:15 142:12 161:14,15 163:24 164:3,9 164:13,15 184:25 193:25 <b>a.m</b> 4:2,5 44:23,25 45:1,3 84:21,23,24 85:1</p> <hr/> <p style="text-align: center;"><b>B</b></p> <hr/> <p><b>B</b> 16:2 52:5 208:2 209:8 <b>back</b> 13:6 22:21 33:14 45:2 49:2 52:19 67:21 72:9 84:25 94:14 106:22 114:25 117:10 122:17 123:7 126:7 126:12 139:17 140:25 141:1 151:8 152:13 165:14 166:8 167:3,3 170:12 176:23 190:13,13,16,18,20,25 191:1,5 192:15 195:4,6 199:12 200:23 206:14 208:4 211:13 220:11,13 226:20 227:2,3 232:9 234:2 <b>backed</b> 150:12 <b>background</b> 8:24 87:4 88:25 89:7,8 <b>backing</b> 229:10 <b>backwards</b> 206:24 <b>bad</b> 85:20 <b>balance</b> 147:17,19,25 148:2 148:25 157:22 158:4,24 163:25 173:13 180:22 181:5 181:18 186:18 188:19</p>	<p><b>balancing</b> 187:1 <b>baled</b> 102:9 <b>ballpark</b> 19:18,25 <b>barrier</b> 128:13,17 129:2,8 130:14 <b>barriers</b> 128:21 131:8 <b>based</b> 18:10,25 21:12 22:12 23:4,15 25:24 28:18,24 30:13 44:7 49:20 57:13 63:2,22 71:9 94:11 99:7 100:15 104:13 111:3 121:12 122:18 142:17 151:17 154:10 155:1,4,12,14 156:10,14 177:23 200:25 201:1 207:21,23 226:15 228:14,17 229:7 243:19 246:13,20 <b>baseline</b> 103:20,22 173:16 174:15,21 175:7,8,10,14,19 176:5 <b>basically</b> 9:1 12:8 49:19,23 50:5 52:18 53:5 56:12 96:21 102:12 108:8 113:13 127:4 139:18 191:3 213:6 214:19 237:9 <b>basin</b> 124:12 <b>basis</b> 34:20 153:11,17 170:15 181:2 190:7 197:20 204:9 221:9 227:5 <b>batches</b> 58:15 <b>Bates</b> 57:22 <b>Bay</b> 7:4,7 <b>bear</b> 41:22 50:20 55:19 121:23 <b>beating</b> 83:13 <b>becoming</b> 83:13 <b>bedrock</b> 132:19 <b>beef</b> 55:7 62:16 182:15 <b>began</b> 4:1 174:6 243:19 <b>beginning</b> 121:12 151:20 185:1 218:2 <b>begins</b> 175:22 180:7 202:19 203:9 <b>behalf</b> 1:16 59:21 60:9,18 61:10 85:3 214:3</p>
--	---	---



**behave** 15:21  
**belief** 211:23  
**believe** 7:25 8:10 9:5 10:9  
 14:15 21:22 29:25 30:3  
 47:17 48:16 50:10 58:2,5  
 71:12 75:21 86:8,17 88:22  
 90:21 95:19 96:3 99:9  
 111:5 116:9 134:18 145:11  
 154:4 155:25 164:4 165:12  
 167:1 181:3 196:21 199:3  
 207:25 221:4,7,7 222:11  
 226:13 228:17,18 236:21  
**believed** 71:16  
**beneath** 236:10  
**benefit** 19:8 49:25  
**Benton** 161:11  
**Bermuda** 108:9 109:12 172:7  
 173:1,4,5 174:2,13  
**best** 26:3,6,13 27:2 29:14  
 33:9 41:3 52:24 97:20  
 99:23 107:20 186:2 187:2  
 220:2 236:1 243:6,19  
**better** 33:22 34:12,14,23  
 35:15 36:13,25 41:24 43:2  
 46:11 97:24 99:22 101:25  
 133:12 151:12 152:3 185:12  
 185:15 215:2 216:8  
**beyond** 81:23 82:8,13 191:20  
 218:1  
**big** 76:25 77:14 100:21 150:1  
 194:13 232:3  
**bigger** 194:8 225:10,12  
**billion** 200:16 201:23 207:9  
 207:16,20 208:9,14 209:22  
**Billy** 48:12  
**biomass** 109:25 114:8  
**bird** 71:19,19  
**birds** 79:16  
**bit** 94:16 116:8 155:1 167:4  
 223:8 242:21  
**blanket** 34:6 35:4  
**blend** 70:24 180:12,14  
**blended** 71:1 72:1  
**block** 131:11 140:2  
**blocking** 131:5,12

**blunder** 218:10  
**BMP** 186:1  
**BMPs** 185:17 188:5 191:10  
**board** 119:23  
**Bob** 4:7,20 11:19 41:16 82:18  
 152:5 160:4 239:1  
**bodies** 6:22 9:18 85:25 93:12  
**body** 9:20 73:13 74:7,10 78:6  
 78:11,17 81:22 85:23 88:17  
 112:13,14 123:16,20,23,24  
 125:18 196:7,8  
**boil** 19:24  
**bolded** 167:7  
**Boston** 2:16  
**bother** 57:23 140:13  
**bottom** 13:11 17:2 39:11  
 62:25 68:25 89:5 97:1  
 104:6 105:1 114:14 132:3  
 186:24 192:6 193:12 196:25  
 198:25 205:25 213:18,23  
 220:17 229:6 246:24,25  
**bounced** 38:25  
**box** 2:23 25:8 198:25  
**boy** 246:20  
**bracket** 169:12  
**brain** 154:21  
**branch** 214:6  
**Bray** 202:20,23  
**break** 18:18 19:1 38:7 41:23  
 44:20 67:17 106:14,16  
 123:2 152:7,8 188:7 194:15  
**breaking** 145:22  
**breakpoint** 226:11 248:19  
**breakpoints** 227:20  
**breaks** 228:2,3  
**briefly** 93:11  
**bring** 13:21 114:3 120:12  
**bringing** 158:16  
**brings** 8:5  
**Britain** 157:14  
**broad** 37:20 38:22 39:9 199:6  
 199:9,10,14 200:13 201:23  
 202:1,7 204:11,13 207:14  
 207:18 208:16 209:15,25  
 210:6,13,17,23 211:13,24

212:2,7 218:19,21 233:20  
 240:9  
**broader** 202:1  
**broadly** 54:14,16 249:19  
**broiler** 108:24 109:16 111:9  
 113:8 114:23  
**broke** 45:4 106:25  
**broker** 183:13,14,18 189:11  
**brokers** 183:20  
**brought** 13:20,23 31:12  
 158:5 160:6 189:15  
**brush** 199:9,10,14 200:13  
 201:24,25 202:1,7 207:14  
 207:18 208:16 209:15,25  
 210:6,13,18,23 211:13,25  
 212:3,7 218:19,21 240:9  
**budget** 172:3  
**buildup** 89:10  
**built** 39:21 108:23  
**bulk** 132:18  
**bunch** 95:2  
**burden** 42:8  
**business** 26:24 29:13 33:1  
 187:4 202:11 228:7 229:20  
**buy** 46:4,7,9  
**buyers** 192:11  
**bytes** 38:7

---

**C**


---

**C** 1:6 2:1,19 4:14 68:25 69:5  
 69:10 117:18 208:7,24  
 209:6 211:3 253:1,1  
**calcium** 127:1 129:16 168:5  
**calculated** 38:21 137:15  
 226:25 227:9  
**calculation** 153:16 209:3  
**calculations** 169:18 201:14  
 211:10  
**calibration** 90:3  
**call** 8:10 12:16 83:11,16 93:6  
 106:15 164:21 199:8 214:8  
 231:6  
**called** 26:23 166:17 223:22  
 238:15,16 242:22  
**calls** 49:12 50:3 51:14,20

<p>250:4  <b>Cal-Maine</b> 2:22 4:20  <b>capacities</b> 169:5  <b>capacity</b> 1:5,7 55:6 122:15,22  129:6 150:14 191:14  <b>caption</b> 7:17,22  <b>capturing</b> 132:5  <b>care</b> 68:10,13,16 85:19  153:13  <b>career</b> 7:12  <b>careful</b> 39:20  <b>carefully</b> 193:5  <b>Cargill</b> 2:9 4:17,18  <b>carries</b> 117:21  <b>carrying</b> 74:7 76:22 125:20  <b>case</b> 5:14,21 7:14,16,19,22  8:5,7 9:2 10:8 11:20,21  13:18 29:5 33:21 39:23  40:10,10 42:6 48:2 52:21  66:3 68:4 112:10,11 113:16  122:2 145:10 150:5 153:25  162:15 163:25 178:13 179:3  180:9 181:15 237:4 238:22  253:11  <b>cases</b> 13:6 20:20,20 34:16  46:20 71:13,14  <b>cash</b> 238:20  <b>catch</b> 69:4  <b>catching</b> 132:7  <b>categorical</b> 44:5 236:19  <b>categorically</b> 14:23 28:16  40:11,20  <b>categories</b> 38:23 39:1,9 64:14  156:4 224:18 227:25 228:10  228:13,14 230:15 236:4  237:18,23 243:20 244:17  <b>category</b> 38:25 64:17,20  224:21 227:6,12,14 230:5  230:18 233:7 238:15,16  241:24 243:14 244:5,21  248:25  <b>cattle</b> 55:7 69:2,18,25 70:5  83:1,3 98:3,7,18 99:5,9  102:10 150:5  <b>causative</b> 134:3,21</p>	<p><b>cause</b> 1:17 112:10 252:7  <b>caused</b> 6:24 30:10  <b>causes</b> 235:3  <b>causing</b> 46:21  <b>caution</b> 204:7  <b>cautious</b> 24:20  <b>ceiling</b> 139:23  <b>center</b> 202:5  <b>centimeters</b> 240:18 241:8  <b>central</b> 190:11  <b>certain</b> 11:25 27:1 88:3,4  146:2 153:2,5 156:17  218:17 220:9,9 229:24  233:9  <b>certainly</b> 111:2 140:13  <b>certainty</b> 73:24  <b>Certificate</b> 3:7  <b>certified</b> 1:20,21 253:6  <b>certify</b> 252:3 253:8,16,19  <b>cessation</b> 114:6  <b>cetera</b> 57:14 125:14 185:24  220:3 221:24,24 228:13  <b>challenges</b> 179:23 185:5  187:24 188:9  <b>change</b> 44:21 45:4 84:18  123:2 125:14 129:4 130:19  137:3,5 151:9 233:21 236:3  <b>changed</b> 220:15  <b>changes</b> 105:4 130:8  <b>changing</b> 143:23  <b>channel</b> 139:2 148:13  <b>characteristic</b> 245:25  <b>characteristics</b> 221:24 224:4  236:8 244:14 246:5,6 247:1  <b>characterize</b> 37:21 221:22  <b>characterized</b> 93:22  <b>chart</b> 173:15 207:22 249:3  <b>cheap</b> 193:13  <b>cheaper</b> 32:21 55:20  <b>chemical</b> 96:5 126:20 128:21  128:24 129:2,8,12  <b>chemically</b> 83:22 118:10  126:4  <b>chemistry</b> 67:2,4  <b>Chesapeake</b> 7:4,6</p>	<p><b>chicken</b> 70:6 83:4,4  <b>chickens</b> 84:12 191:4  <b>circumstance</b> 32:11 41:18  87:16 182:6  <b>circumstances</b> 44:4 216:1  <b>citations</b> 90:22  <b>cite</b> 90:7 113:1  <b>cited</b> 108:16 115:6 152:17  177:4,6 195:14  <b>cites</b> 14:22 94:17 110:5  119:10 167:17 168:6  <b>citing</b> 117:24  <b>City</b> 1:18 2:7  <b>clarify</b> 56:14 57:6  <b>class</b> 224:10,16 226:18,23  230:2 244:8,24 245:1  <b>classes</b> 11:2,4,5,7,15,18,24  12:1  <b>classification</b> 230:2 236:19  <b>classroom</b> 11:5  <b>clay</b> 48:13 49:10 129:24  130:3,8 132:16  <b>clays</b> 126:4  <b>clean</b> 193:14  <b>clear</b> 7:21 41:16 50:15 124:11  <b>Clearly</b> 187:24  <b>clients</b> 183:15  <b>climb</b> 110:10  <b>close</b> 55:18 180:22 232:21,22  240:11  <b>closely</b> 180:16  <b>Coale</b> 1:15 3:4 4:4,24 5:5,7  13:11,24 14:13 16:17 19:14  25:10 32:11 41:2 45:4  49:24 51:8 53:7 54:17 56:9  60:1,12 61:1,14 65:7 70:8  72:9 85:2 86:10 87:16  88:19 92:15,16 99:17  101:15 106:24 107:10  116:23 117:12 123:9 132:4  133:11 137:9 142:14 145:15  147:19 152:15 155:21  156:18 164:21 165:13,17  195:6 210:17 218:19 234:4  235:1 252:3,12 254:1</p>
--	--	--

<b>Coblentz</b> 107:18 108:6 <b>code</b> 220:22 250:16 <b>coefficient</b> 122:18 195:18 196:10 197:1,19 198:8 199:25 200:10 201:4,24 202:2,7 203:16 204:1,4 205:7 207:24 209:16 217:6 <b>coefficients</b> 197:25 200:5 203:10,13 204:2 205:4 <b>coined</b> 219:14 <b>colleague</b> 14:3 <b>colleagues</b> 170:16 <b>collect</b> 122:7 <b>collecting</b> 136:9 <b>collection</b> 178:25 201:1 <b>collective</b> 229:8 <b>College</b> 2:20 <b>colon</b> 157:12 <b>column</b> 100:6,7 101:9 109:9 109:23 111:7 112:24 114:14 133:20 137:10 142:15 153:3 172:21 173:12 174:2,12 176:21 185:2 192:6,25 202:15 224:21 226:19 242:22 <b>columns</b> 173:1,8 <b>combination</b> 176:16 <b>combined</b> 118:3 <b>come</b> 8:20 24:1 27:1,9 28:11 32:1 58:3,7 59:1 66:20 68:19,23 80:12 89:14 90:19 106:9,11 133:13 139:22 151:13 152:2 156:6 195:17 195:17 198:22 203:25 208:11 <b>comes</b> 64:13 67:12,12,23 68:16,22 70:15 72:12 81:2 91:2,7 92:9 95:25 143:1 158:23 170:12 176:8 181:9 190:3 226:5 <b>comfortable</b> 14:6,9,10 72:17 80:23,25 81:1,6 <b>coming</b> 10:11 98:24 100:1 220:13 <b>comment</b> 135:1 169:23	<b>comments</b> 23:14 132:12 <b>commercial</b> 30:24 31:4,22 32:3 33:5,5 45:7,19,22 55:13 57:9 87:9 89:19 98:5 154:12 242:15 246:15,18,21 <b>Commission</b> 252:23 <b>common</b> 22:16 49:14 71:12 71:12 75:13 137:23 139:15 155:2 182:2 214:8 232:24 <b>commonly</b> 22:20 179:7 <b>commonplace</b> 32:10 <b>communicated</b> 48:1 <b>community</b> 11:11 <b>companies</b> 50:11,13,20 53:2 180:11 <b>comparable</b> 140:15 <b>compare</b> 106:4 136:16,20 137:4 225:23 <b>compared</b> 111:12,22 136:22 168:3 <b>comparison</b> 103:9 250:21,22 <b>comparisons</b> 103:2 137:14 <b>complaint</b> 169:19 <b>complete</b> 95:10 102:24 <b>completely</b> 38:2 <b>completeness</b> 147:16 194:21 <b>complex</b> 215:12 <b>complexity</b> 203:15 205:6,19 <b>complicated</b> 157:14 <b>complicating</b> 111:9 215:6 <b>component</b> 18:19 110:2 116:18 200:8,11 220:16 <b>components</b> 116:20,21 200:9 <b>composition</b> 132:15 <b>compositions</b> 130:13 <b>compounding</b> 216:14 <b>compounds</b> 129:16,16,17 168:5 <b>concave</b> 124:12 <b>concentrated</b> 70:14 93:21 157:16 <b>concentration</b> 76:3 91:15 95:1 100:24 103:2,17 105:4 105:19 111:20 112:1,3,8 114:17 127:19 148:7 196:1	202:8 215:15,22 <b>concentrations</b> 93:13 94:17 95:16 96:19 99:21 103:1 105:25 138:19 214:2 <b>concept</b> 223:10 <b>concepts</b> 148:5 <b>concern</b> 46:22 65:5 85:9,12 85:14 86:4,6 123:13 163:3,4 165:21,24 170:6 176:25 178:4 <b>concerned</b> 86:1 139:5 153:9 162:2 <b>concerns</b> 6:13,15 181:17 <b>concerted</b> 185:3 <b>conclude</b> 60:20 177:25 <b>concluded</b> 213:24 <b>conclusion</b> 50:4 51:15,21 84:10 185:2 187:23 214:12 233:17 250:5 <b>conclusions</b> 104:25 108:15 180:3 202:15 203:8 <b>concurrence</b> 106:1 <b>conditions</b> 34:5 124:25 125:14 126:9 170:9 197:9 203:14 205:5 <b>conducted</b> 86:19 179:14 <b>conducting</b> 49:20 <b>conductivity</b> 78:15 <b>conference</b> 49:11 <b>confident</b> 235:7 <b>confined</b> 147:5 193:1 <b>conflicting</b> 187:9 <b>conforms</b> 139:15 140:24 <b>confused</b> 21:5 56:12,15 <b>confusing</b> 218:14 223:17 230:12 <b>confusion</b> 134:11 <b>connected</b> 112:13 123:23 125:17 <b>consensus</b> 214:4,11 <b>consequences</b> 85:21 <b>consequently</b> 21:9 <b>Conservation</b> 171:4 <b>conservative</b> 245:7 <b>consider</b> 51:18 53:7,10 54:3
---	--	---

89:7 249:8,11	<b>controlled</b> 215:8	252:7 253:17
<b>considerably</b> 175:8	<b>controlling</b> 142:1 148:11	<b>CORRECTION</b> 254:3
<b>consideration</b> 215:12	215:1 217:14	<b>CORRECTIONS</b> 254:1
<b>considered</b> 13:5 57:25 58:18	<b>convenience</b> 152:7,8	<b>correctly</b> 15:2 17:9,18 20:2
89:3 97:6 106:1 109:19	<b>conversation</b> 49:23 52:13	50:22 58:24 69:17 95:18
163:14 169:1 214:17 248:11	178:8 188:13,23 212:18,20	103:5,25 105:7 126:16
<b>considers</b> 161:16	<b>conversations</b> 48:12,13 49:13	131:22 134:5 138:1 149:22
<b>consistent</b> 105:19 108:16	49:19	157:17,24 173:20 174:24
110:6	<b>converse</b> 189:23	185:18 198:23 201:20
<b>consistently</b> 101:18	<b>conversion</b> 195:24,24 198:22	225:14 232:2
<b>constant</b> 119:20 120:8 121:17	202:9 204:9 211:18,19,21	<b>correctness</b> 196:12
166:11	213:8 239:6 240:4 248:17	<b>correlated</b> 117:8
<b>constantly</b> 187:1	<b>convert</b> 65:10 101:4 239:2	<b>correlation</b> 114:17 115:4,7,7
<b>constituents</b> 18:2,19 19:1	<b>conveyance</b> 78:14	115:12 117:6
<b>constructed</b> 129:2	<b>convinced</b> 162:18	<b>cost</b> 32:18 33:7 41:2,6,9,22
<b>consultants</b> 11:13	<b>copies</b> 92:17	42:13 50:20 52:25 55:4,9,11
<b>consumption</b> 154:6 171:9	<b>copy</b> 13:17,20,21 108:5 165:4	55:13,16,19 187:3
<b>contact</b> 129:25	196:16	<b>costing</b> 186:25
<b>contacted</b> 10:9	<b>corn</b> 72:1 190:21,23 191:4,5	<b>costly</b> 186:13 193:12
<b>contain</b> 64:1 123:13 253:17	<b>corner</b> 167:6 198:25	<b>costs</b> 50:19 187:8
<b>contained</b> 57:9 113:25	<b>correct</b> 5:15 15:14,15 17:23	<b>cough</b> 133:17
<b>contains</b> 56:24	17:24 22:4 36:17 38:13	<b>counsel</b> 4:5 219:21,23
<b>contaminant</b> 91:15	39:3 44:18 45:21 48:22	<b>count</b> 13:16
<b>content</b> 78:9 129:24 130:3	50:24 54:22 55:1,2,8 60:24	<b>counted</b> 57:15
148:7	62:14 63:5,6 68:7,8,12	<b>counter</b> 40:13
<b>contents</b> 142:18	69:20,23 74:24 75:14,16	<b>counties</b> 161:11 209:6
<b>context</b> 113:24 115:16 185:13	89:18 92:25 93:1 94:2,3,13	<b>country</b> 21:14 64:12 90:23
188:10,25 219:12 234:19	96:1 98:1 99:1 101:14,22	223:4 239:10
<b>continue</b> 20:25 91:1 126:7	102:1 104:12,15 105:22	<b>County</b> 1:18 253:4,7
<b>continued</b> 44:25 84:23	112:22 117:2 119:3 135:16	<b>couple</b> 49:11 111:13 113:4
106:21 108:11 109:4,4	141:19 142:6,6 143:8	119:21 166:16 210:8 228:14
110:4 111:24 114:7 143:11	144:21,25 145:19 147:6	<b>course</b> 9:22,23 19:18 55:5
144:7 145:16 152:12 195:3	148:15 149:11 150:2 153:22	130:19 166:22 219:15
234:1	154:7,13 156:2,8 164:25	<b>courses</b> 5:13
<b>continues</b> 119:6	166:23 168:7 172:16,24	<b>court</b> 1:1 5:6 41:11,19 42:18
<b>continuing</b> 129:10	173:3,6,23 174:1,17,23	54:9 67:18,20 164:5,16
<b>continuous</b> 123:22 230:3	176:3,6 177:3 179:10	250:2,5,9
<b>continuum</b> 226:14 227:23	180:25 186:6 189:10 191:8	<b>covered</b> 12:9
228:16	191:12 200:17 201:19 207:1	<b>Cox</b> 113:1
<b>contrary</b> 14:20 33:2	207:3,4 208:13 213:22	<b>co-authors</b> 169:25 204:21
<b>contribute</b> 155:17 162:14,22	221:7,8 224:12,20 225:17	<b>create</b> 32:6 63:15
<b>contributing</b> 40:1	225:19,22 230:22 231:15	<b>created</b> 153:6
<b>contribution</b> 16:7 214:25	234:16 235:24 237:3 241:1	<b>creates</b> 96:4
<b>control</b> 118:4 181:8,8,10	242:4,6 244:7 245:18,21	<b>creek</b> 137:24 201:4
193:10	247:23 248:3,5,20,22 252:5	<b>creeks</b> 77:21

**criteria** 184:1  
**critical** 133:25 143:1 219:12  
 219:13,22,24  
**critically** 178:1  
**criticism** 177:10,20  
**crop** 6:19,20 15:6,10 19:6  
 21:16 22:13,15 23:24 32:24  
 33:7,19 43:8,10 63:17 64:2  
 65:2,15,16 90:4 95:17  
 101:17 102:4 105:20 110:25  
 118:4 119:6 154:11 155:2,8  
 156:5 167:16 168:3 180:17  
 240:19,20,21,22 241:14,16  
 241:20 242:1  
**cropping** 103:4 104:11  
**crops** 20:4 88:6 91:1 94:11  
 96:6,22 97:2,8,14 98:14  
 101:19 103:10,10 109:25  
 156:17 168:2  
**crosses** 200:20  
**CRR** 253:24  
**crunched** 204:21  
**crystal** 124:10  
**CSR** 253:24  
**cubic** 229:23  
**cursor** 99:7  
**curve** 228:2  
**cut** 151:23 213:17  
**cutting** 148:18  
**cycle** 135:7  
**C-O-B-L-E-N-T-Z** 107:22

---

**D**

---

**D** 3:1  
**dairy** 145:11 150:13  
**dam** 130:24  
**Daniel** 167:23  
**Darned** 95:7  
**data** 19:24 30:6,8 75:22  
 76:24 77:8 79:20,22 80:1,5  
 86:14 88:17 90:22 115:10  
 120:1 121:2,9,11 160:15,19  
 161:7 196:2 197:2,4,6,24  
 198:9,15 201:1,2,3,13 204:8  
 204:21,24 209:1 211:19

213:10 228:2,10 230:23  
 235:8  
**dataset** 122:1,3,4,6,7,10,11  
 122:19,20 139:14,17,18  
 140:25 163:20  
**datasets** 117:7,7 121:21  
 195:20  
**data-point-by-data-point**  
 204:9  
**date** 178:18 222:14  
**day** 1:17 117:15 187:5 251:1  
 252:8,18 253:22  
**deal** 183:17,17 215:19 217:18  
 217:25 239:21  
**dealer** 33:6  
**dealing** 11:11 19:21 20:5,21  
 21:6  
**dealt** 7:23 52:15,16 53:17  
**decades** 22:11 95:14 105:25  
**December** 7:20 8:8 10:6,7  
**decide** 29:10 54:9 218:24  
 245:6  
**decided** 52:22 229:1  
**deciding** 52:6 197:20  
**decision** 18:24 25:18 26:10  
 33:1,14 53:5 187:5 193:22  
 193:25 229:10  
**decisions** 18:9,16 23:2,4  
 26:13 28:17,21 44:6 51:9  
 180:7 218:23,25  
**declaration** 13:3,17,25 14:5  
 14:11,14,16  
**decline** 89:10 90:24 91:5  
 105:14 108:11,13,18,24  
 118:5 119:9,13,15,16,20,23  
 121:15,18 122:5,18 174:6  
**declined** 109:3 119:5 121:6  
**declining** 120:9 175:23  
**decomposition** 16:6  
**decrease** 72:5 90:15 103:11  
 148:14,22  
**decreased** 151:10  
**decreasing** 186:24  
**deem** 135:8  
**deemed** 96:10,11

**deep** 65:9 98:16  
**deeper** 111:12,23 112:2  
 198:13 240:18 241:7  
**deeply** 65:11 66:7  
**defecate** 98:18  
**defendant** 133:5  
**defendants** 1:12 4:15,21 7:13  
 7:22 8:2 11:19,21 41:12,19  
 42:5,6,19 47:13 60:10,18  
 61:11 67:7 70:24 74:14  
 76:10,14 81:17 82:16 84:12  
 85:3,4 86:19,24 88:16  
 120:17 124:5 130:7 160:7  
 163:25 164:10  
**defense** 59:21 62:2 102:20  
**defensible** 84:10,16 119:11  
**deficiency** 14:25 15:8,9,25,25  
**deficient** 191:16  
**define** 86:20 159:25 160:1  
 245:2  
**defined** 100:10  
**definitely** 88:14  
**definition** 85:16  
**definitive** 104:9  
**defray** 187:7  
**degrades** 118:14  
**degree** 73:23  
**degrees** 132:2 235:15,18  
**DeLaune** 222:11  
**deliberate** 130:11  
**deliberately** 129:13  
**delineation** 139:15  
**delivery** 73:18 201:4  
**Delmarva** 6:7,16,24 7:1,24  
 8:2 71:11  
**demand** 20:7 61:8,17 168:3  
 194:2  
**demonstrate** 43:11,12 122:19  
 213:25  
**dense** 201:12  
**density** 132:18  
**Department** 50:17,18 52:21  
 193:23  
**depend** 127:13  
**dependent** 34:4 91:5



<p><b>depending</b> 34:7 67:2 108:25 245:10</p> <p><b>depends</b> 20:17 31:12 46:23 65:15 98:9 126:9 127:13,16 127:19,25 129:17 168:12,18 188:13,22 216:6 229:21</p> <p><b>deposited</b> 69:1 99:11</p> <p><b>deposition</b> 1:15 4:1,4 5:14,16 14:3 24:18 25:5 108:3 251:4 252:4 253:12,18 254:1</p> <p><b>deposits</b> 98:7 190:11,15</p> <p><b>depth</b> 66:2,10,16,17,23 98:16 98:16 111:25 114:19 132:18</p> <p><b>depths</b> 65:23 66:12</p> <p><b>derived</b> 120:21 221:15</p> <p><b>describe</b> 12:20 131:14</p> <p><b>described</b> 126:21 130:4,12,14</p> <p><b>describing</b> 211:9</p> <p><b>description</b> 119:1</p> <p><b>descriptive</b> 230:4,5</p> <p><b>descriptor</b> 236:15,16</p> <p><b>descriptors</b> 237:15</p> <p><b>designated</b> 47:25 48:1</p> <p><b>designation</b> 218:13 226:7</p> <p><b>designations</b> 226:4</p> <p><b>designed</b> 179:14,17 219:5,8</p> <p><b>desire</b> 154:11</p> <p><b>desk</b> 140:7</p> <p><b>despite</b> 110:2 187:6</p> <p><b>destination</b> 45:13</p> <p><b>detailed</b> 99:8</p> <p><b>details</b> 50:15 184:17</p> <p><b>determination</b> 30:23 218:4</p> <p><b>determine</b> 61:12 121:18 132:20 146:13 156:15</p> <p><b>determined</b> 60:12,17 61:1,11 61:14 62:2 90:3 120:5 134:4 191:16</p> <p><b>determining</b> 81:21</p> <p><b>detour</b> 86:10</p> <p><b>develop</b> 111:24 122:1,4,6,16 122:18 179:8 185:17 197:19 197:25 217:6</p> <p><b>developed</b> 12:16 66:24</p>	<p>119:10 120:11 121:2 122:8 151:17,21 195:15 196:14 223:7 235:7 243:6 250:12</p> <p><b>developer</b> 197:14</p> <p><b>developers</b> 243:5</p> <p><b>developing</b> 9:3 151:22 157:19 195:16 197:17 204:11,13 205:11</p> <p><b>development</b> 10:24 12:18 181:12 191:17</p> <p><b>devising</b> 53:25</p> <p><b>de-emphasized</b> 243:22</p> <p><b>diagram</b> 135:24 155:22 177:13</p> <p><b>diagrams</b> 166:16</p> <p><b>dial</b> 245:6</p> <p><b>Dicks</b> 48:14 49:18,19 60:19</p> <p><b>Dickson</b> 2:13</p> <p><b>diet</b> 71:19,25</p> <p><b>difference</b> 34:17,18 35:12,25 128:22 217:4 226:15 235:2</p> <p><b>differences</b> 130:3 179:18 196:5</p> <p><b>different</b> 12:17 15:21 26:8 31:14 32:13,19,23 36:23 38:12 39:8,21 42:18 52:3 64:14 88:7 99:10 100:6,7 108:12,13,17,18 109:1 118:18 120:6 124:24 125:16 126:8,23 127:3 129:4,21 130:13 134:12 152:6 169:1 171:11 188:17 191:25 192:17 196:11 212:11 223:6 223:8,9,9 227:24 228:15 230:1 232:20 235:23 242:21 244:13,17 246:5,25</p> <p><b>differently</b> 24:10 235:22</p> <p><b>difficult</b> 15:20 37:10 181:7 185:7 187:16 204:18</p> <p><b>difficulties</b> 132:4</p> <p><b>direct</b> 3:5 5:3 176:14</p> <p><b>direction</b> 152:6 157:6</p> <p><b>directions</b> 83:24</p> <p><b>dirt</b> 131:18</p> <p><b>disagree</b> 90:13,16,17,18,20</p>	<p>205:16</p> <p><b>disagreement</b> 205:1</p> <p><b>discharge</b> 87:13</p> <p><b>discuss</b> 47:24 164:23</p> <p><b>discussed</b> 88:15,17 101:2 109:19 130:9 148:5 178:21 178:22</p> <p><b>discussing</b> 148:1</p> <p><b>discussion</b> 7:13 9:23 24:11 62:10 101:16 123:5 194:22 240:7</p> <p><b>dismissed</b> 87:1</p> <p><b>disperse</b> 125:5</p> <p><b>dispute</b> 30:9</p> <p><b>dissolution</b> 118:3</p> <p><b>dissolved</b> 118:16 125:20 126:3,18,22 128:6 197:7 202:25 203:17 205:8,14 215:5,15,18 216:2,18,19 217:1</p> <p><b>distance</b> 140:17 142:1 150:18 224:11 230:10 231:19 235:4 245:8,8,13 249:13</p> <p><b>distances</b> 224:15 234:7</p> <p><b>distinctions</b> 228:12</p> <p><b>distinguishable</b> 228:9</p> <p><b>distributed</b> 71:1 228:19,24 229:11</p> <p><b>distributing</b> 183:14</p> <p><b>distribution</b> 157:15 158:13</p> <p><b>DISTRICT</b> 1:1,2</p> <p><b>disturb</b> 161:1,3</p> <p><b>disturbed</b> 160:14,20 161:4,7 161:9</p> <p><b>disturbingly</b> 160:6,11</p> <p><b>divide</b> 206:24 228:20 240:14</p> <p><b>divided</b> 118:9</p> <p><b>Doctor</b> 36:4 165:9 183:4 202:21 215:3</p> <p><b>document</b> 13:7 46:19 115:22 144:23 170:21 227:3</p> <p><b>documented</b> 159:4,6,9 160:5 181:16</p> <p><b>documents</b> 13:5</p> <p><b>doing</b> 37:14,16,17,20,22</p>
---	---	---



49:22 68:9 111:18 145:6 236:22 <b>dominant</b> 39:25 <b>double</b> 169:12 <b>downhill</b> 81:6 <b>downward</b> 67:1 <b>dozen</b> 196:25 <b>Dr</b> 4:4 5:5 13:24 14:13,21 16:17 19:14 25:10 30:9 32:11 41:2 45:4 48:13,19,25 49:6,10,18,19,24 51:8 53:7 54:17 56:9,19 57:17 58:21 58:21,23,24 59:6 60:1,12,19 61:1,14 65:7 70:8 72:9 85:2 86:10,15 87:16 88:19 89:22 90:2,9 92:8,10,15 93:4 94:18 99:17 101:15 106:24 107:25 116:23 117:12 119:10 120:22 123:9 132:4 132:4,11,11 137:9 142:14 145:15 147:19 152:15,23 155:21 156:18 160:19,25 164:21,23 165:2,6,13,17,18 165:21,25 166:24 167:22,23 169:19,20,23,24 170:7,16 171:13 176:25 177:1,12,13 177:17,24 178:9,16 179:6 179:22 195:6,10,12,14,15 195:15 196:1,10,13,19,20 196:22 197:12 198:19,20 199:3 206:3,12,13 207:22 210:17 211:2 212:18,21,23 212:25,25 213:6,12,15,23 213:24,24 214:4,19 218:19 234:4 235:1 <b>drain</b> 124:12 <b>drainage</b> 87:5 129:11 <b>dramatic</b> 149:16 153:19 <b>dramatically</b> 110:20 113:15 176:22 <b>draw</b> 65:12,25 244:17 <b>DREW</b> 1:4 <b>drive</b> 31:4,23 <b>drop</b> 133:17 175:22 185:10 <b>Dropping</b> 147:14	<b>DRP</b> 214:25 215:1,19 <b>due</b> 30:17 39:17 131:12 168:3 221:21 <b>duly</b> 1:20 4:25 253:9 <b>dynamic</b> 118:14 <b>D-I-C-K-S</b> 48:15 <b>D.C</b> 8:15  <hr/> <b>E</b> <hr/> <b>E</b> 2:1,1 3:1,3,3 123:9 213:14 253:1,1 <b>earlier</b> 12:21 75:21 141:1,8 180:24 189:15 193:20 201:16 206:3 237:17 <b>earth</b> 80:15 162:10 <b>easier</b> 39:4 150:4 <b>easily</b> 249:9,11,15 <b>east</b> 2:13 17:2 <b>eastern</b> 71:10 <b>easy</b> 240:4 <b>eat</b> 98:18 <b>ecological</b> 123:13 <b>ecologists</b> 135:8 <b>economic</b> 96:4 143:1 188:14 <b>economics</b> 32:16,18 53:8,10 <b>economists</b> 53:15 <b>ecosystem</b> 87:12 188:21 <b>edge</b> 125:3,4 132:5,8 178:25 200:18 201:3,3,21 202:5 233:1 245:12 <b>EDMONDSON</b> 1:4 <b>education</b> 11:4,7,9 150:10,11 183:19 <b>effect</b> 129:21 135:5 <b>effective</b> 18:11 19:11,19 23:11,16 25:11,16,18,20,25 26:2,7 27:7 28:6,19,22,24 29:18 44:8,12,14 50:2 52:1 54:6 55:4,9,16 182:8,13,21 186:18 202:24 <b>effectively</b> 27:17 28:9,12 32:14 43:20 95:15 182:10 182:12,16 183:12 <b>effectiveness</b> 25:17 132:2 <b>efficiency</b> 25:17 186:20	<b>efficient</b> 18:11 19:3,9,13,19 23:7,10,16,22 25:11,16,24 26:1,6 27:6,13 28:6,18,21 28:24 29:18 32:21 33:8 42:12 44:8,12,14 50:2 52:1 52:2 54:6 182:7,21 186:18 <b>efficiently</b> 19:5 23:8 27:17 29:12 32:14 43:19 182:10 182:12 <b>effort</b> 185:3 <b>efforts</b> 55:22 <b>eight</b> 62:23 236:12 <b>either</b> 13:13 93:23 98:4 100:18 104:11 129:1 137:4 160:16 161:4 178:11 184:21 184:21 190:1 228:14 236:14 246:1,14,17,21 253:20 <b>elastic</b> 89:10 <b>element</b> 56:11 249:15 <b>elemental</b> 56:10,14 <b>elements</b> 188:23 236:18 242:3 243:20 <b>elevate</b> 87:18 106:4 <b>elevated</b> 30:10,17 31:1 37:3 75:18 76:4,6,7,10,21 77:17 77:19 79:1,23 80:2,6,10 85:18 91:3 93:13 102:18 105:15 106:10 124:1 162:13 163:3,4 175:7,8 176:12 <b>elevation</b> 104:8 119:17 137:3 137:5 <b>elevations</b> 128:25 <b>eleven</b> 155:9 <b>Elrod</b> 2:12 4:16,16 25:4,9 37:17 62:8 67:15 116:6 139:20 140:3,8 <b>emphasized</b> 243:22 <b>emphasizing</b> 112:18 <b>empirical</b> 226:15 235:2 236:3 240:13 <b>empirically</b> 228:9 <b>employ</b> 186:4 <b>employed</b> 5:8 31:23 <b>employee</b> 7:13 <b>employees</b> 7:23
--	--	---

<b>employing</b> 195:23	201:23 207:9,15 210:22	26:20 39:12 72:1 124:9,11
<b>enacted</b> 63:13 64:7,22,23	243:25	129:23 141:2 142:9 171:10
<b>encountered</b> 129:1	<b>equate</b> 14:23	184:3 189:16 190:3 193:20
<b>encourage</b> 52:22	<b>equation</b> 198:13,24 199:3,7	194:6,6 222:17 235:25
<b>encouraged</b> 192:9	207:8,12 209:15,18,25	247:5
<b>ended</b> 84:8	210:3,10,15,20,24 211:9,10	<b>exception</b> 31:9 195:9,12
<b>endorse</b> 28:5	211:14,21 212:6 213:8	209:2 211:17
<b>ends</b> 46:16 78:10	<b>equivalent</b> 238:22 240:8	<b>excerpting</b> 144:23
<b>endure</b> 238:4	<b>erosion</b> 39:15,17,23 40:3,22	<b>excess</b> 90:4,6 110:24 153:14
<b>engagement</b> 10:1	75:10 131:19 222:1 224:10	153:17 157:12 158:12
<b>Engel</b> 165:19,25 166:24	224:16,17,18 225:13 226:5	159:10
169:19 170:7 176:25	228:25 229:4,5,16,17 244:3	<b>excesses</b> 157:22
<b>Engel's</b> 164:24 165:2,6,22	244:14,19,24 245:19	<b>excessive</b> 93:24 95:15 156:4
169:24 177:13,24	<b>errors</b> 213:7	237:12,24 238:17
<b>enhance</b> 19:6 113:8 192:12	<b>especially</b> 66:6,23 110:4	<b>exchanging</b> 120:7
192:20	<b>essential</b> 14:24	<b>excreted</b> 167:15
<b>enhances</b> 55:5	<b>essentially</b> 220:22	<b>excuse</b> 20:17 65:13 71:7,18
<b>enrich</b> 98:8	<b>established</b> 132:7 243:9	88:4 104:8 118:2 140:11
<b>enriched</b> 7:7 71:4 85:15	<b>estimate</b> 62:3 166:1	143:20 160:3 169:3 173:23
93:23 97:3,9 99:6	<b>estimates</b> 61:25	213:21 243:3 246:8
<b>enrichment</b> 72:7 143:14,17	<b>estimation</b> 60:19,20,22,24	<b>exercise</b> 120:22
144:10 145:18 146:15,19	<b>et</b> 1:11 57:14 125:14 185:24	<b>exhibit</b> 13:9 14:11 57:21
<b>enrollment</b> 187:10	220:3 221:23,24 228:13	92:16 107:10 108:2,21
<b>entered</b> 202:4	<b>Europe</b> 153:5,13	117:10 133:10 135:14
<b>entering</b> 98:11	<b>eutrophication</b> 93:11 112:10	152:16 165:5,16 166:14
<b>entire</b> 28:1,2 142:18	112:14 133:25 134:22 135:2	179:22 194:17 196:17 206:9
<b>entitled</b> 85:9 179:23 218:3	135:5,7	214:16 222:18 239:12 249:4
<b>entity</b> 17:25 18:23	<b>evaluate</b> 38:22 221:25 233:15	<b>exhibits</b> 222:16
<b>entries</b> 57:15 224:7,8	<b>evaluated</b> 162:25	<b>exist</b> 56:10,13
<b>entry</b> 241:2	<b>evaluating</b> 202:24	<b>existing</b> 191:23
<b>environment</b> 1:6 34:19 43:14	<b>evaluation</b> 28:8 104:8 118:23	<b>exists</b> 57:6 153:13
86:22	220:1,8,8,19,21 234:21	<b>exit</b> 124:22
<b>environmental</b> 5:13 34:2	<b>event</b> 77:9,15 82:22 230:23	<b>expansion</b> 191:18,24
35:15 36:13,16 37:5 46:22	230:24 232:21 253:21	<b>expect</b> 14:5 56:7 110:9 141:2
65:5 81:25 85:21 86:19,20	<b>events</b> 178:24 235:2	149:6 163:2 214:14 227:13
171:11 186:7,21 189:2	<b>eventually</b> 127:24	231:4,8,12,23 233:2
229:12	<b>Evers</b> 109:14	<b>expectations</b> 185:17
<b>environmentally</b> 27:21 33:22	<b>everybody</b> 187:21 214:9	<b>expected</b> 227:10,11 230:24
34:12,13,23 36:20 43:2	<b>evidenced</b> 235:14	<b>expecting</b> 188:17
46:11 86:2 203:1	<b>exact</b> 178:17	<b>experience</b> 9:14,17 21:13
<b>EPA</b> 133:24 134:12,12,15	<b>exactly</b> 19:20 140:8 163:12	50:8,10 52:19,20 57:13
<b>equal</b> 34:14,22 35:21,22,23	189:14 198:1	183:13
35:24 119:16 228:20,21	<b>examination</b> 3:5 5:3 147:17	<b>experiment</b> 37:14,22 45:13
<b>equally</b> 202:23 228:19,24	147:24 194:23	173:17
<b>equals</b> 199:11,14,22 200:15	<b>example</b> 15:20,23 17:5,7	<b>expert</b> 14:22 47:14,20 48:5

48:10 81:16 85:2 88:15 107:12 <b>expertise</b> 9:2,21 10:15 71:24 81:24 82:9,13,15 88:14 205:20 <b>experts</b> 48:1 <b>Expires</b> 252:23 <b>explain</b> 113:12 137:19 195:11 198:17 214:22 <b>explained</b> 10:11 176:24 178:11 <b>explanation</b> 85:14 145:25 <b>explode</b> 139:20 <b>export</b> 143:15,18,23 144:11 146:20 148:14,23 164:1 180:17 <b>exports</b> 180:23 <b>extend</b> 181:22 <b>extension</b> 11:4,6 183:19 186:4 <b>extent</b> 47:10 84:9 99:5 102:6 130:2 133:1 138:24 153:1 154:1 <b>extract</b> 113:19 <b>extractable</b> 197:4 <b>extraction</b> 197:1 198:8 199:25 203:1,10,12,16 205:4,7 209:16 <b>extremely</b> 31:10,16 34:4,4 39:16 <b>extremes</b> 179:17 <b>eyes</b> 80:19 <b>E-mail</b> 214:16 217:23	166:12 170:13 195:24,25 196:2 210:2 215:6 216:14 234:21 243:8 247:12 <b>factors</b> 39:21,24 40:3,17 41:5 42:1 132:25 139:7 146:12 155:17 169:1 189:2,4 200:10 217:14 221:22 233:11 236:4 <b>factually</b> 147:9 <b>Fahrenheit</b> 235:15,18 <b>fair</b> 24:6 31:8 56:5 98:21 99:12 116:12 134:7 138:13 149:24 160:4 177:25 <b>fairly</b> 22:20 <b>fall</b> 64:12 80:14 <b>falls</b> 38:22 64:14 81:4 99:13 132:21 215:8,22 <b>familiar</b> 13:8 22:7 91:10 153:16 171:23 187:12,13 194:7 222:3 226:6 <b>far</b> 65:25 101:9 131:4 142:9 153:8 162:1 188:18 197:11 201:12 232:18 249:20 <b>farm</b> 6:18,18 17:22 18:1,9,16 18:18 19:5,8 23:1,3,4,5,6,7 23:14,15 25:13 26:7,15 27:5 28:16 29:7,7,12,17 32:16,19 32:21,23 33:1,3,15 42:24 43:6 44:5 46:6,8,16,17,17 46:18,23 47:1,4 51:9 52:23 52:23 53:8,14 73:13 87:23 100:8,10 149:1 180:16,21 181:1,2,5,9 182:3,4,4,12,13 182:20 184:2,3,4,6,12 188:5 188:17,19,20 191:10 192:18 193:4 218:24 219:3,7 <b>farmer</b> 6:20,20 26:2,3,11 33:14 41:7,12,22 42:9 43:5 43:22 45:18 55:11,17 96:9 147:10 150:7 180:9,13 181:25 182:11,17,25 183:7 183:16 193:8,8 220:14 <b>farmers</b> 11:13 21:12 22:2 26:12,25 27:10,15 28:20 31:3 54:19 55:3,9,15 56:17	63:16 64:8 96:5 147:4 149:18,25 150:4 183:10,23 186:4,11,16 189:8 190:23 193:9 <b>farming</b> 49:15 179:24 <b>farmland</b> 6:22 <b>farms</b> 2:15 4:13 46:16 79:9 79:14 100:7 109:16 184:14 185:6 186:5,8 <b>farther</b> 90:14 94:16 138:15 143:9 <b>fast</b> 92:9 95:24 97:21 <b>faster</b> 110:10 <b>fate</b> 167:7,10 <b>fates</b> 69:3,12 126:8 127:3 <b>fathom</b> 190:19 <b>Fayetteville</b> 2:14,20 <b>FD-36</b> 135:19 137:4 142:22 156:1 <b>fed</b> 97:8 154:1 <b>federal</b> 11:14 41:11 <b>feed</b> 55:7 70:9,15,19,21,24 71:7 72:7,11,19 153:6,20 154:1 167:14 180:7,12,14 181:9 188:3 189:12,20 193:10 <b>feeding</b> 97:18 193:2,5 <b>feel</b> 49:14 <b>feet</b> 66:12,16,19 <b>fell</b> 138:5 <b>felt</b> 9:20 235:7 <b>fertility</b> 6:11 15:19 237:19 238:6,19 <b>fertilization</b> 63:3 <b>fertilized</b> 98:4 <b>fertilizer</b> 30:24 31:4,17,22 32:3 33:4,5,6,6 43:25 55:5 55:13,21 64:6 82:24 83:3 87:9 91:8 96:14 98:5 113:7 113:23 119:17 153:7 154:12 168:14,20 169:14 182:4 239:13,14,22 240:17 241:9 242:9,15,24,25 243:1 246:1 246:14,18,18,21,22 <b>fertilizers</b> 96:6
---	--	--

---

**F**


---

**F** 253:1  
**face** 162:10 167:1  
**faced** 96:5  
**facilities** 136:7  
**facing** 187:24  
**fact** 10:2 49:8 86:1 91:20  
110:2 133:24 165:25 171:20  
177:17,23 218:6  
**factor** 39:17,22 40:1 41:2,10  
41:10 90:15 111:9 143:22

<b>fescue</b> 108:9	229:9	<b>folks</b> 56:12 151:22
<b>field</b> 12:21 16:4 22:16 25:15	<b>finding</b> 106:1 188:2 189:6	<b>follow</b> 37:12 169:17 190:12
27:11,11 29:23 34:3,5 37:23	<b>findings</b> 95:13	<b>followed</b> 179:20
38:15,16,18,20 41:4,24	<b>fine</b> 29:3 48:2 106:17 133:19	<b>following</b> 44:24 77:9 84:22
42:20 43:3 45:12,18 46:2	172:9 205:12	106:20 145:7 152:11 175:23
69:22 78:2,3,5,7,8,9 82:24	<b>Finish</b> 41:15	195:2 212:23 233:25
82:25 83:2,25 87:5,5,10	<b>finished</b> 107:8	<b>follows</b> 5:2
98:8,25 99:2,3 105:13	<b>firmly</b> 162:18	<b>FOODS</b> 1:11 2:12
110:17 123:12 124:10,11,13	<b>first</b> 4:25 5:14,16 7:12,19,19	<b>footnotes</b> 100:11
124:22,23,23 125:3,3,4,12	14:3 16:17 25:7 28:8 48:14	<b>forage</b> 20:4,6,6,8,10 21:8
125:17,19 126:17,18,23	58:10 77:15 88:24 90:16	43:16 54:25 55:5 63:17
127:6,11,11,12,22 128:2,4,4	93:7,10,18,18 96:17 100:5	64:2 65:8,11,18,19,22 66:11
128:5,6,7,7,14,18,25,25	101:16 103:12 105:3 109:6	67:11 68:21 97:2,14,18
130:17 131:19 132:5,8	109:22 111:8,16 112:11	98:14,17 100:8 101:17,19
141:2,8,9,9,12,17,19 142:10	127:5 133:21,22,23 137:14	102:3 103:22 104:3 105:5
142:10 151:10 156:14 179:9	142:15 150:20 151:20,23	105:10,20 108:8 109:18,25
190:8 200:18,20 201:3,17	153:3 192:25 196:23 202:18	113:16 114:8 188:3 189:12
201:21 202:5,5 213:10	213:1 224:3,21,21 227:8,12	189:20 206:16
214:13 219:5,7,15 229:12	230:18 234:17 237:1 244:21	<b>forages</b> 95:21 101:24,24
241:20 249:9,11	247:5 253:9	<b>foregoing</b> 252:4 253:16
<b>fields</b> 24:2,12 30:3,4,23 34:24	<b>firsthand</b> 21:11,13 30:12	<b>forget</b> 13:16 26:22 157:13
35:25 36:9,22 38:1,10 39:5	52:20	187:18
40:2,16 43:9 46:25 93:20	<b>Fisher</b> 132:11	<b>form</b> 20:24 21:21 22:9 23:12
97:9 99:6 105:6 190:10	<b>fit</b> 121:25	24:17 27:22 28:7 30:21
<b>fifteen</b> 6:5 59:4 90:6 119:18	<b>Fitzgerald</b> 9:6	31:11 33:13 34:1,15 35:16
<b>fifteen-centimeter</b> 114:19	<b>FIV</b> 238:5,18 248:12 249:1	36:15 37:1 40:18 41:8 42:3
<b>figure</b> 139:9 153:14 166:18	<b>five</b> 101:20 103:3 228:21	43:4 44:9 46:12 47:16 50:3
167:11,12 168:6 178:19	231:10 240:18 241:7 246:5	51:14,20 53:23 54:7 67:14
198:24 199:1 206:18 207:19	246:25	68:5,18 72:14,21 73:2 74:2
209:10 211:4 212:6 227:3	<b>five-minute</b> 44:19	74:16 75:20 76:16 77:1,3,7
232:3 239:20	<b>fixed</b> 83:22,22 126:25	79:3,5,25 80:3 81:19 83:9
<b>figured</b> 140:1 216:11 217:7	<b>fixing</b> 139:22	84:14 85:22 86:3,7 88:11
<b>figures</b> 157:10 234:10	<b>flat</b> 120:2	110:18 120:15 124:3 128:19
<b>figuring</b> 116:5	<b>flip</b> 33:2 165:5 177:12	130:18 131:8 134:23 143:19
<b>fill</b> 187:16	<b>flooding</b> 24:5	144:22 145:4,20 146:23
<b>filter</b> 131:22,25	<b>Florida</b> 190:11,24	149:15 150:6,25 154:15,17
<b>final</b> 155:16 185:11 186:11	<b>flow</b> 9:19 123:21 124:22	158:9 159:2,8,11,21 160:9
203:7 243:23	128:1 137:15 148:7,15,23	160:18 161:2,6,13,21 162:4
<b>finally</b> 156:22 214:24	168:12 169:6 172:8 173:7	162:7,23 164:2,6,12,19
<b>financial</b> 42:8 53:16 186:12	174:20,25 175:1,4,6 176:7	168:13,19 169:22 170:2,18
189:1	185:22,25	182:9,23 183:9 190:5
<b>financially</b> 32:21	<b>flows</b> 81:6	193:16 222:8 250:4 253:14
<b>find</b> 27:13 95:6,8 97:16	<b>flumes</b> 136:10	<b>formation</b> 190:18
124:19 160:24 162:12 163:2	<b>focus</b> 7:4 51:9 148:9 149:4	<b>forms</b> 56:13 57:5 187:16
181:25 182:2 183:21 222:19	220:2	228:2

**formulations** 71:25  
**forward** 21:18  
**found** 60:22 102:25 107:4  
 110:6  
**four** 100:6,7,17,19 103:4,18  
 104:16 132:14 176:4 228:20  
 236:12  
**fourth** 102:23 105:2  
**fractured** 132:19  
**fragmented** 153:21 154:5  
**Frank** 1:15 3:4 4:4,24 5:7  
 83:10 252:3,12 254:1  
**frequency** 14:25 230:25  
 233:13  
**frequent** 232:21  
**frequently** 93:12  
**fresh** 76:11 93:12 135:6  
 215:25 217:8,13,15,19,25  
**freshly** 215:7 216:15  
**fueled** 135:9  
**full** 109:22 142:15 198:14  
 253:17  
**fully** 100:10 192:9 206:6  
**fun** 238:8  
**fund** 50:11,14,23,25  
**funded** 51:5  
**funds** 51:1  
**further** 45:12 129:6 138:11  
 139:16 142:24 143:14,22  
 144:10 145:16,16,18 148:13  
 150:18 154:9 157:14,15  
 253:16,19  
**future** 191:17

---

**G**

---

**G** 3:3  
**gas** 139:22 235:19  
**gauges** 136:11  
**Gburek** 152:22,23 222:21,22  
**gendered** 182:11  
**general** 1:5 2:6 8:21 9:14  
 12:7,8 19:14,17 20:12,13  
 33:18 35:18 62:23 65:14,22  
 85:14 88:13,24 108:15,20  
 115:11 117:5 118:25 151:1

151:2 162:16 170:1,20,21  
 171:9 184:2 202:9 211:16  
 228:6 240:7  
**generality** 15:22 170:8  
**generalization** 201:2  
**generally** 16:8 51:23,25 52:4  
 54:16 62:22 64:9,10 77:15  
 85:8 95:22 106:10 115:14  
 134:17 135:4,6,12,13  
 167:22 168:11 169:11,14  
 171:14 176:22 217:18  
 228:10  
**generate** 150:19 156:13  
 163:19 230:24,25 231:5  
 233:2  
**generated** 25:13 28:10 75:8  
 76:17,20 77:18 78:2,7,9,16  
 124:21 125:17 127:15  
 128:24 137:17,22,23 138:8  
 138:10,17,21 144:17 145:13  
 146:7,9 149:6 166:10 184:6  
 189:24 196:6,7 201:7  
 227:17  
**generic** 166:1  
**generous** 116:8 250:17  
**gentlemen** 211:1  
**geographic** 192:13  
**geologic** 190:18  
**geology** 126:13 132:12  
 190:15  
**George's** 2:19 4:14  
**getting** 15:13 19:7 31:10 33:9  
 49:14 77:20,23 88:24  
 147:24 148:24 155:11  
 158:21,22 159:24 190:24  
 191:20  
**give** 6:9 15:12 17:4 26:20  
 37:11 39:11 44:5 61:20  
 64:2 71:19 86:6 124:9  
 145:24 183:2 189:11 193:20  
 213:12 235:10 237:10  
**given** 21:16 25:4 40:14 84:10  
 128:20 150:7 158:15 231:6  
**gives** 151:5 206:14 207:11  
**giving** 203:24

**gleaned** 49:13  
**Globally** 151:3  
**go** 16:24 21:1,3 24:18,19,23  
 33:14 37:21 78:18 84:18  
 87:23 89:17 94:9 95:25  
 102:23 106:8 107:7 112:2  
 114:25 117:10 122:7 123:1  
 124:23 125:4,25 126:1  
 127:21 141:13 147:18 151:8  
 152:6 156:18 158:23 176:23  
 178:7 182:19 185:1 187:23  
 190:13 194:15,16 195:6  
 200:23 201:21 203:6 208:4  
 209:5 219:7 220:11,13  
 226:20 227:1,3,15 233:18  
 233:21,22 240:25 247:16  
**goal** 6:17 35:17,18 97:20  
 110:19 114:1,3 151:19  
 159:1,3 205:18  
**goals** 142:17 148:8  
**goes** 18:22 52:19 70:9 72:11  
 72:19 75:4,5 92:8 95:24  
 102:13 126:19 183:14  
 197:11,21,21,22 207:7  
**going** 8:23 10:12 14:18 18:5  
 18:24 20:5,11 24:24 25:2  
 26:10 30:22 34:3,7 43:7  
 46:19,21 47:21 48:7 52:22  
 57:23 68:19 74:7 76:13  
 77:8 83:11,15 89:1 90:18  
 93:6 95:22 96:13 104:13  
 107:3,3 113:18 120:3  
 126:10 139:21 140:11 141:1  
 141:9,13 143:17 149:6  
 152:1 157:2 158:18 162:10  
 166:9,10 175:17 177:25  
 178:2 187:3 190:12 192:19  
 193:23 198:15 201:22  
 207:13 208:17 211:18 225:4  
 229:6,9 230:13 232:12  
 233:9,9,12,13 235:11  
 236:19 237:9 238:7 240:24  
 245:16,16,17,19,22 246:1,2  
 246:11,13,17 248:7 250:8  
 250:22



**good** 8:14 25:7 29:3 33:1  
 47:9 49:9 88:2 104:19  
 106:13,24 116:15 139:13  
 140:10,24 141:11 149:9,10  
 149:11 150:16 153:14  
 197:13 217:21 250:25  
**Gordon** 14:21 79:20 86:15  
 90:2  
**Gotcha** 225:5  
**gotten** 212:11  
**governing** 193:24  
**gradient** 130:20  
**grain** 70:8,19,22 71:3,5 100:9  
 101:20 103:21 104:1 189:16  
 189:17,22,23 190:3,9  
**grains** 71:17 95:12 101:20,25  
**grant** 11:9 82:16 156:13  
**graph** 211:4 212:1  
**grass** 20:9 54:25 55:6 63:2  
 65:11 66:6 68:22 69:19  
 108:9 109:13 113:17 172:7  
 173:1,4,5 174:2,13  
**grasses** 20:6,6,11 43:5,23  
 62:13,21,22 65:8,18,19,22  
 66:11 67:11 107:19 108:8  
**gravity** 130:20  
**grazing** 69:2 98:3  
**great** 157:14 215:19  
**greater** 20:3 103:20 109:17  
 148:18,22 168:11 175:18,19  
 203:14 205:6 221:4 230:17  
 231:1,16,25 234:7 238:17  
 241:18,25  
**greatest** 148:14,17  
**greatly** 192:12  
**grew** 103:9  
**gross** 166:12 196:9 204:17  
**grossly** 37:20  
**ground** 70:5 75:4,5,25 125:23  
**groundwater** 154:13  
**group** 26:20 243:6  
**grouped** 240:1  
**groups** 11:24 26:19,24 27:9  
**grow** 23:24 55:7 91:1 96:21  
 113:18

**grower** 114:22 181:4  
**growing** 6:21 32:24 43:5  
 70:14 88:6 97:14 113:17  
 150:15,15 189:15,17,22,23  
 190:21 241:20  
**grown** 65:15,16 70:10 95:21  
 154:2  
**grows** 154:2  
**growth** 15:11 19:6 45:20  
 88:10 102:15 113:9 135:7  
 153:4 154:5  
**guess** 8:18 68:13 105:1,20  
 132:3,11 133:11 189:7  
 216:6 217:3 223:21 225:10  
 237:4  
**guessing** 240:24  
**guidance** 64:13 170:21  
 182:25 184:19,19,20  
**guidances** 64:22  
**guidelines** 151:5  
**guy** 101:3 235:12  
**G-B-U-R-E-K** 222:19

---

## H

---

**H** 16:17 22:21,23,24 133:15  
**half** 100:22 147:3 196:25  
 246:24  
**halfway** 112:25 133:23  
 202:18  
**Hammons** 2:5 4:9,9,11  
 139:22 140:1  
**hand** 13:7 92:16 133:10,12  
 235:8 252:8 253:22  
**handed** 152:15  
**handing** 133:11  
**handle** 217:15  
**handy** 165:15  
**Hang** 13:9 135:17 165:24  
 168:15 177:16  
**happen** 40:6,21,23 70:7  
 112:14 122:23 146:5,6  
 165:2 196:16 201:17,18  
 231:2 234:22,23 235:21  
**happened** 10:7 21:22,23  
 22:18 31:7 140:21

**happens** 22:20 77:6,11,12  
 99:14 112:16 125:22 126:5  
 126:13 127:5,8,10 166:6  
 175:2 234:24 236:4 244:2  
**hard** 107:5 190:19 202:12  
**hardship** 96:4  
**harvest** 108:12 114:7 118:4  
 119:6 168:1  
**harvested** 95:13 101:18,19  
 102:8  
**Harvesting** 109:25  
**hauling** 56:2 192:11  
**hay** 102:3,9,9,18 108:12  
 109:4 110:7,8  
**hazardous** 59:17,18  
**head** 87:22 230:11 237:16  
**header** 224:15  
**headers** 234:11 236:11  
**heading** 100:12 137:11  
 156:20 167:7 187:23  
**headings** 236:15,16  
**healthy** 71:19  
**hear** 10:5 223:15 231:9  
**heard** 10:3 110:23 218:18  
**hearing** 5:20,20,24 10:11,17  
 10:21 11:1 12:5,10 13:1  
 50:22 58:11 101:3 131:21  
 201:20  
**hectare** 100:16,19,21 153:12  
 157:13 169:12 172:22  
 173:21 174:16,21 176:1  
 225:6,13,21 229:15,23  
 239:23 240:5 244:22  
**heightened** 123:13  
**held** 62:10 112:5 123:5  
**help** 19:6 27:24 50:14 53:2  
 57:6 99:21 114:21 116:13  
 149:7 150:16 185:16 187:7  
 187:20 194:4 197:19 220:4  
 220:16 223:16  
**helped** 94:2  
**helpful** 202:10  
**helping** 50:11  
**Herron** 167:23  
**heterogeneous** 16:19,20,25



18:23 <b>hey</b> 53:2 <b>hid</b> 168:18 <b>high</b> 30:20 31:5,10,16,23 32:2,6 34:25 38:16 39:15,16 42:25 44:3 46:1 85:9,12,15 85:16 91:18 96:11,18,20 101:8 107:1 109:25 113:7 120:12,12 128:4 129:5 130:17 141:2,8,12,17 142:22 151:7,7 159:20,24 160:6,12,12 162:21 164:11 178:24 179:1 219:1,1,18,20 224:1,1 225:18,20 226:4,4 227:22,22 228:13 230:15,15 234:11,12,18,18,18 236:10 236:10,20 237:11,24 245:17 248:4,4 <b>higher</b> 15:8,24 26:15 30:25 34:14 37:9 38:18,19,21,24 38:25 40:15,15 72:2 104:1 112:1 126:17 128:24 188:17 188:18 216:4,5 220:1 227:15 241:21 <b>highest</b> 233:7 236:21 241:24 <b>highlighted</b> 165:8,10 <b>highly</b> 91:1,5 93:22 136:1,4 136:15 170:2 <b>hill</b> 2:9 4:17,17 69:8 124:16 <b>hinder</b> 187:10 <b>hinges</b> 193:3 <b>historic</b> 64:16 90:2 190:14 <b>historical</b> 91:6 <b>historically</b> 20:21 21:6 63:1 71:16 72:3 233:8 <b>history</b> 84:10 <b>hit</b> 112:21 129:8 <b>hold</b> 83:9 181:20 <b>holding</b> 12:22 <b>hole</b> 130:24 <b>homogenous</b> 17:1 <b>honest</b> 161:25 <b>honestly</b> 58:8 59:14 200:23 201:11 <b>honesty</b> 162:1	<b>hope</b> 202:12 233:16 <b>hopefully</b> 31:19 162:17 <b>horizontal</b> 100:12 <b>hours</b> 8:25 116:6 <b>house</b> 45:6 <b>houses</b> 60:5 182:17 <b>human</b> 240:5 <b>hump</b> 124:15 <b>hun</b> 80:4 <b>hundred</b> 239:5 <b>hundreds</b> 79:23 80:1 <b>hung</b> 36:5 <b>hurt</b> 230:11 <b>hydrologic</b> 148:5 197:8 <b>hydrology</b> 203:18 205:9 <b>hypothetical</b> 36:8 40:7,9,13 40:14 82:22 119:9 122:23 <b>hypotheticals</b> 37:20	136:16,21,23 137:5 140:16 142:8 154:1 159:6,9,14,18 160:5 161:16 162:3,8,16,20 163:7 184:15 250:3,10,19 <b>illustrated</b> 153:25 <b>imagine</b> 196:17 <b>imbalance</b> 193:4 <b>imbalances</b> 153:6 193:3 <b>immediate</b> 157:5,20 <b>immediately</b> 97:1 212:22 240:19 241:14,15 <b>impact</b> 9:18 37:6 123:24 243:23 <b>impacted</b> 149:20 <b>impaired</b> 134:1,5 161:17 <b>imperial</b> 225:24 <b>implement</b> 185:4 186:13 187:3,4 <b>implies</b> 188:13,14 203:14 205:5 215:1 <b>import</b> 163:25 <b>importance</b> 39:18 <b>important</b> 79:19 87:3 110:1 116:18 204:13 243:7 <b>importantly</b> 138:23 156:22 <b>imported</b> 70:19,22 <b>imports</b> 180:22 <b>imposed</b> 121:17 <b>impossible</b> 28:13 <b>improve</b> 28:2 151:19 <b>improved</b> 151:24 <b>inaccurate</b> 154:24 171:13 <b>inappropriate</b> 24:3 104:20 <b>inches</b> 65:23 231:10,11 <b>include</b> 113:7 181:12 184:19 <b>included</b> 13:5 249:13 <b>includes</b> 87:12 <b>including</b> 69:3,12 186:7 <b>incorporate</b> 111:18 <b>incorporated</b> 127:2 228:3 240:19,19 241:13,18,22,23 <b>incorporation</b> 111:10 148:4 <b>incorrect</b> 14:23 15:5,17 <b>increase</b> 89:13 94:17,25 128:7 143:15,17 144:11
---	--	--

<p>146:3,4,20 214:1,3  <b>increased</b> 55:6 76:3 112:7  121:7 143:21,23 146:8  155:17 176:17  <b>increases</b> 95:1 112:8 242:8  <b>increasing</b> 111:19 129:24  143:21 240:25  <b>incremental</b> 150:9  <b>independent</b> 121:21 122:11  122:20  <b>independently</b> 247:3  <b>index</b> 10:16,24 11:16 12:12  12:17 35:7,17,22 36:3,17,24  37:3,4,6,7,9,13 38:8,14,18  39:2,9 43:11 46:20 54:1,12  116:20 150:24 151:3,12,15  163:1,6,9,13,19,22 184:12  184:22 218:20,21 219:3,11  219:21,25 220:5,19,21  221:19 222:4,18 223:4,5  224:6 227:2 235:3,7 236:5  238:6,19 249:8 250:2,9,17  <b>indexing</b> 247:22  <b>indicate</b> 49:6 95:13  <b>indicated</b> 56:20 104:7  <b>indicates</b> 13:4 106:9  <b>indices</b> 11:3 49:4 82:3 139:4  151:20 179:8 220:23 223:7  <b>indisputable</b> 214:12  <b>individual</b> 180:9 181:18  188:16 193:8,9 214:10  236:18  <b>individuals</b> 11:11 12:15,23  26:24 49:12 56:17 235:6  250:15  <b>industry</b> 11:23 153:5 180:8  192:4  <b>industry-wide</b> 53:16  <b>infiltrate</b> 125:5,15 126:1  <b>infiltrates</b> 126:23  <b>infiltration</b> 125:1 132:20  133:1  <b>information</b> 8:24 73:18 89:1  89:7 92:10 99:8 116:11  212:23 226:21 249:16</p>	<p><b>ingested</b> 102:10  <b>initial</b> 8:10  <b>injected</b> 135:9 241:9  <b>injunction</b> 5:20 10:10,21  12:5,9 13:1  <b>innovative</b> 188:5 191:10  <b>inorganic</b> 65:9,12  <b>input</b> 43:22 49:14 62:12  153:6  <b>inputs</b> 180:15 181:5,8  <b>inquiry</b> 214:20  <b>inside</b> 32:23  <b>instance</b> 15:12 17:21 24:2  32:12 142:16 235:10  <b>instances</b> 22:18 31:21 104:1  <b>institutional</b> 187:8  <b>instruct</b> 83:15  <b>instructive</b> 35:18 249:21,23  <b>instrumentation</b> 136:11,13  <b>instrumented</b> 136:15  <b>intact</b> 18:25  <b>integrated</b> 180:10  <b>integrator</b> 180:8  <b>integrators</b> 11:18 50:1,25  51:6,12,19 52:9 53:11 54:4  194:1,3,7  <b>intend</b> 165:4  <b>intense</b> 179:19  <b>intensification</b> 153:4  <b>intensity</b> 178:24  <b>intent</b> 170:20 197:16  <b>interaction</b> 137:11 241:11  <b>intercept</b> 210:2  <b>interchangeably</b> 57:4  <b>interested</b> 10:14 145:15  233:18 253:21  <b>interface</b> 6:12  <b>interim</b> 156:23 157:1  <b>interpose</b> 147:15  <b>interpret</b> 148:20 150:10  158:2 189:14 227:11  <b>interpretation</b> 92:12 145:5  213:9 217:17,22 224:25  229:1 232:25 234:25  <b>interpreted</b> 213:2,7</p>	<p><b>interpreting</b> 137:20 213:8  235:6  <b>intersection</b> 219:15,16  <b>intimate</b> 250:13  <b>intimately</b> 184:17 222:5  <b>introduce</b> 145:6  <b>introduced</b> 83:17 185:25  190:10  <b>introduction</b> 93:17,19 144:15  <b>introductory</b> 157:11 164:22  <b>involve</b> 53:3,4 187:25  <b>involved</b> 6:6 8:6 10:17 12:11  12:18,22 46:14 49:11,12,23  50:8,11 52:6 61:6 151:22  188:14  <b>involvement</b> 12:14  <b>Iowa</b> 189:16,17 190:4,10,20  190:23  <b>iron</b> 127:1 129:16 168:5  185:23  <b>IRW</b> 16:13 20:5 21:12 30:15  31:19,22 32:2,6,9 49:3,15  65:20 107:15,19 132:25  135:3 170:14 196:2  <b>isolated</b> 56:10  <b>isolation</b> 144:24  <b>issue</b> 57:17 150:3,7 159:15  177:11 180:19  <b>issues</b> 6:11,12 7:14,15 8:21  8:22 10:16,16 11:12 161:23  <b>items</b> 57:14</p> <hr/> <p style="text-align: center;"><b>J</b></p> <hr/> <p><b>J</b> 56:9  <b>Jackson</b> 2:24  <b>January</b> 1:18 4:4 253:23  <b>job</b> 26:12 180:13,22  <b>Joern</b> 58:21,23,24  <b>John</b> 2:12 4:16  <b>Johnson</b> 56:19 79:20 86:15  86:16 89:23 90:2,9 92:8,11  119:10 120:22 122:5 160:19  160:25 195:10,12,14 196:1  196:20 199:4 206:3 212:25  213:6,24</p>
---	---	--

**Johnson's** 14:22 30:9 107:25  
 198:19,20 199:4 206:12,13  
 207:22 211:2 212:24  
**Jones** 9:8,10  
**journal** 171:3,4,10  
**journals** 32:1  
**judge** 83:11,16  
**judgment** 114:24 161:5  
 228:17,18 229:8 243:7,19  
**jumping** 239:9  
**jumps** 174:18  
**jury** 5:6  
**justifies** 243:10  
**justify** 242:16  
**J-O-E-R-N** 58:23

---

**K**


---

**K** 2:19 4:14 17:8,16 57:1  
**Karst** 126:13,15 132:12  
**keep** 51:11 83:10 110:16  
 117:14,16 149:25 150:4  
 165:15 187:17  
**kilogram** 101:10 142:23  
 143:13 144:9 174:21 176:1  
 199:14,21 226:1 248:13  
**kilograms** 100:16,19,25  
 142:23,25 153:12 157:12  
 169:11 172:22 173:20  
 174:16 225:25 239:23 240:5  
**kind** 7:14 9:12 10:11 14:4  
 24:1 32:6 49:5 54:17 61:7  
 62:1 78:5 91:24 98:2  
 130:13 136:23 139:13,16,17  
 140:23 170:1 173:8,16  
 178:14 179:7 190:19 222:1  
 232:23 240:9 249:7  
**kinds** 124:18  
**kinetics** 118:2  
**Kleinman** 203:22  
**know** 7:4 8:4,12,23 9:10  
 10:13 11:22 12:1,6 18:3  
 19:20,21 21:12 22:19 30:15  
 31:7 39:11 47:8,12,19 48:7  
 50:21 52:8 53:24 55:22  
 56:1,3 58:21 59:1,2,20,24

60:4,8,9,17,19 61:10,13  
 62:4 65:20 66:13,14,17 67:8  
 67:23 68:6,6 70:11,12,18,21  
 70:24 71:1,9,14 72:4,6 73:7  
 73:14 74:11,17,18,22 75:17  
 77:10,12,24 78:1,3,12,14  
 79:6,8,11,15,16 81:11,16,24  
 82:5,21 83:2,6,7 84:3 85:7  
 88:23 89:5 100:3 102:16,20  
 116:13,15 120:17 123:25  
 124:5,7 127:1 130:5,7,9,10  
 132:9 133:4 134:19 136:22  
 136:25 137:6 139:16 141:4  
 142:9 143:2 151:6 156:5,10  
 156:25 157:3 160:11,13  
 161:8,8,10,24 162:8 163:12  
 164:7 167:21,23 178:8  
 183:8,15 184:14,17 193:7  
 194:12,13 200:8,12 203:3  
 214:4,6 217:11,16,18,24  
 218:8 221:10,11,15 227:5,8  
 227:9 228:5 234:9,17 235:1  
 235:14 236:6,14 237:14,21  
 240:1,6 242:12,18 243:2,10  
 243:11 244:14 249:20  
 250:15,20  
**knowing** 83:6 116:12 146:24  
**knowingly** 104:21 170:7  
**knowledge** 7:19 21:11 30:12  
 31:18 47:13 48:18 71:2,9  
 73:4 78:10,13 79:12 85:2,6  
 114:19 130:7 164:7 170:22  
 214:8 229:8 250:13  
**known** 59:4 63:23 75:15  
 134:8 216:21  
**knows** 60:10 102:21 214:9  
**Kratochvil** 92:23,24 93:4  
 119:25

---

**L**


---

**L** 57:7  
**label** 224:7,8  
**laboratory** 88:3  
**lack** 147:16  
**laid** 213:5 216:2

**lake** 201:5  
**lakes** 134:3  
**land** 7:6 11:9 60:7,13 61:1,4  
 61:15 74:23 75:18 87:17  
 91:6 100:21 109:1 112:20  
 120:5 123:25 124:8 138:15  
 138:15 144:20 149:19,20  
 155:18 156:13 159:20 160:7  
 167:7,16 206:16 216:25  
 219:2 221:1 250:18  
**lands** 112:20 164:11  
**landscape** 7:10 9:18,20 46:24  
 73:17 74:6 149:5 150:13,18  
 170:13 222:1  
**land's** 217:2  
**large** 15:23 54:25 58:9 74:10  
 174:8 176:8 219:16  
**larger** 15:6 20:8 192:13  
**largest** 62:12  
**large-scale** 195:16  
**lateral** 83:23  
**laterally** 66:7  
**laughed** 49:8  
**Law** 2:3,9,13,16,19,22  
**laws** 1:21  
**lawsuit** 21:7  
**lawyer** 8:17  
**lay** 215:25  
**layers** 111:12,23  
**laying** 75:25  
**leaching** 69:13 70:4 112:9,13  
 154:13 169:4  
**lead** 92:21 93:4 152:20  
**leaks** 126:12  
**learn** 12:7 79:19 151:25  
**learned** 32:8 49:9 75:22  
 151:18  
**leased** 29:1  
**leave** 140:5 182:20  
**leaves** 74:4 140:6 158:6  
 201:17,21  
**left** 100:8 190:8 215:2 216:8  
 229:24,25 240:25 241:3  
 242:8  
**left-hand** 100:6 111:7 112:24

133:20 142:15 172:11 246:7	249:2	160:8,16,17 166:2 172:3,21
<b>legal</b> 50:4 51:15,21	<b>limitation</b> 96:2,4 147:11	172:23 173:21 174:18 175:3
<b>legumes</b> 20:6	<b>limited</b> 63:21 96:16 147:3	176:9,15 181:13,19 182:1,3
<b>lesser</b> 30:25	221:2	182:12,14 183:11,24,24
<b>letter</b> 164:23	<b>limiting</b> 40:17 41:5 88:8	184:2,5,16,23 185:6 188:2,3
<b>let's</b> 14:13 16:16 20:4 23:25	<b>line</b> 16:18 39:11 63:14 89:6	189:7,12,18,20,21,24 190:3
24:14 38:7 39:4 44:20	105:2 186:24 193:12 197:5	192:16 216:19,25 217:19,25
45:11 65:18 67:17 69:16	211:15 223:25 224:3 232:19	221:2
84:18 92:14 93:6,11 99:17	243:24 254:3	<b>litter-originated</b> 84:7
102:23 106:4,16 107:7	<b>linear</b> 119:20 120:8 122:17	<b>little</b> 12:17 21:5 39:4 42:18
109:6,10,22,24 111:6,8	198:12,21 211:8	45:11 90:14 94:15 99:22
117:10 121:1 123:1 133:24	<b>lines</b> 17:4 110:22 132:14	120:20 135:23 143:6,9
137:8 142:14 143:10 152:8	196:25 213:23 239:13	152:6 155:1,22 166:16
153:1 155:21 156:18,18	<b>links</b> 192:11	167:4 181:9 188:8 193:10
164:20 165:21 166:14,17	<b>Lisa</b> 1:19 13:14,16 252:5	201:12,25 223:8,9,9,16
167:3,4 171:17 172:1	253:6,24	242:21
174:20 176:23 180:2,5	<b>list</b> 57:8,10,12	<b>livestock</b> 93:21 97:8 153:4,21
185:1 187:6,23 188:7	<b>listed</b> 7:17 57:14 92:25	154:10
194:15 195:6 196:22 199:8	<b>listen</b> 53:2	<b>LLC</b> 4:18
202:14 203:6 205:24 206:13	<b>liter</b> 199:17,18,23 211:6	<b>load</b> 51:2,3 100:17 127:16
208:16,16 219:7 222:19,24	<b>literature</b> 57:14 75:15 216:22	172:8 229:22
223:18 233:21 234:4 236:7	<b>litter</b> 16:8,18 17:5,19 18:10	<b>loaded</b> 188:12,22
239:20	18:12,17 19:16,20,23 20:11	<b>loading</b> 109:2
<b>level</b> 20:17,18,18 23:14,15	20:13,22 21:7,13,15,17 22:5	<b>loam</b> 172:9
26:15 31:2 36:10 37:8	22:12 23:4,5,11,13,15,17,19	<b>loams</b> 137:1
38:19 39:19,25 40:4 48:9	23:22 24:3,12,13,22 25:11	<b>local</b> 48:18 141:23
50:9 53:6,14 72:2 74:10,11	27:5,9,10,11,16,23 28:1,6	<b>locally</b> 28:9 189:23
76:21 87:4 91:7 96:10	28:18,20,22 29:2,18,19,21	<b>location</b> 23:18 25:11 27:16
97:21 103:18 105:15 114:9	30:11,18 32:12,22,25 33:10	46:1,2 50:7 67:3 97:25
120:13 143:1 144:5 146:3	33:21,23 34:3,13,24 36:14	181:16 185:21 192:16
164:18 171:9 199:10 213:1	36:25 41:3,20,24 42:2,14,21	231:23,25
214:1 217:9,12 219:4,6,7,8	43:6,9,24 44:7,15 45:6,8,25	<b>locations</b> 24:15 50:2 80:5
219:9	46:22 47:7 50:1,6,14,23,25	99:10 100:7 101:21 103:4
<b>levels</b> 7:7 31:16 32:2 36:1	51:2,13,19 52:2,4,23 54:19	103:19 104:17 144:25
37:4 63:8 76:7,8 94:25	55:4,12,17,23 56:2 57:9,16	<b>logic</b> 60:21 242:18
95:16 97:17 103:11 105:14	60:2,5,6,14 61:5,8,17 63:1	<b>logical</b> 40:25 111:17
105:25 106:10 108:10,23,25	63:14,18,21,22,24,25 65:1	<b>long</b> 6:3 95:25 96:23 106:8
109:16 110:3,19 113:14	66:20 67:12,12,25 68:6,19	116:7 120:11 171:24,24
114:4 121:6 135:9 162:13	68:24 69:21 70:2 71:3,6	202:18 232:1
164:10 234:20	74:9 75:5,6,19,25 76:11,11	<b>longer</b> 24:24 63:16 71:21
<b>lies</b> 180:8	77:13 83:4 96:9,12,16 98:5	96:9 125:15 129:9 130:20
<b>life</b> 213:10	106:6 108:24 109:2,11	215:20 231:3 234:5 241:21
<b>limestone</b> 132:19	110:16 111:9 113:8,25	<b>long-term</b> 93:24 128:17
<b>limit</b> 24:22 42:1 63:14 139:18	114:7,12,23 116:15,22	181:11,15 185:5
187:9 221:1,5 248:6,9,12,24	127:5 128:5 145:10,13	<b>look</b> 7:18,21 14:14 16:16

28:13 42:17 58:6 78:18 79:20 92:14 93:6 97:1 100:5,11 109:6,22 111:6 120:1 131:15,18,20 145:13 151:8 156:19 164:20 165:22 166:14,17 167:3 172:1 174:20 177:8 181:19 182:7 182:21 190:1 196:22 198:12 198:13,18 199:12 202:14 205:24 206:14 213:13 218:23 223:7 226:20 233:18 234:5 236:7 240:24 242:22 <b>looked</b> 12:5 30:6,8 37:24 47:11 55:25 58:17 59:15 76:24 79:21,22 80:6 86:14 92:7 108:7,8,9,22,24 131:15 163:5,8,21 167:12 171:24 177:2 195:20 204:23 244:5 <b>looking</b> 6:11 13:24 29:5 53:13 57:12 78:1,4 117:11 117:17 133:20 135:21 169:2 183:10 200:7 217:12 240:12 246:7 <b>looks</b> 13:19,22 177:15,16 222:22 223:5,12 246:8 <b>loss</b> 6:21 35:20 38:15 44:3 117:9 121:7 149:2 150:17 151:7,7 162:14 166:11 168:10 169:2,10 170:13 173:7 175:6 181:17 205:14 214:25 219:2 220:1,4,13 223:22 241:21 243:21 248:1 <b>losses</b> 39:16 116:25 123:12 133:8 <b>lost</b> 43:13 168:15 180:21 217:15 244:21 <b>lot</b> 7:5 59:3 66:5 72:23 74:22 75:2 125:4,7 127:3 178:22 186:24,25 201:13,13 204:23 216:5 219:17,19 223:14 225:12 228:12 229:7,8 249:22,24 <b>love</b> 238:7 <b>low</b> 34:24 38:15 46:2 130:22 151:6 168:3 169:5 218:25	224:1 225:5,13 226:4 227:6 227:6,14,14,21,21 228:13 230:14 234:11,18 236:10 237:11,23 238:5,12 239:22 244:21 245:1,2,2,2 248:4 249:5 <b>lower</b> 33:7,7 34:13 37:7 38:20 104:3 109:11 111:11 111:21 112:2 126:18 127:11 155:8 166:17 167:6 <b>lowest</b> 236:20 <b>luck</b> 49:9 <b>lunch</b> 106:14,20 107:13 <hr/> <b>M</b> <hr/> <b>M</b> 115:12 <b>macronutrient</b> 54:24 <b>magic</b> 60:14 <b>magnitude</b> 217:1 <b>maintain</b> 63:9 105:15 186:13 <b>maintains</b> 133:25 <b>maintenance</b> 188:4 191:9 <b>major</b> 100:11 134:2,21 <b>majority</b> 103:1 197:8 <b>makers</b> 56:18 <b>making</b> 18:16 25:18 28:8,20 33:15 88:7 187:1 208:6 <b>male</b> 182:11 <b>manage</b> 6:17 12:20 17:24 26:14 27:2 186:17 <b>managed</b> 17:22 23:14 25:22 29:1 47:4 183:25 193:5 <b>management</b> 6:12 8:21 18:9 18:16 19:19 23:1,3,8 24:8 28:11,17 29:17 32:8 44:6 46:18 47:5,7,9 51:9 53:6,13 54:15 62:13 87:23 147:13 149:1 151:5,9 155:10 157:6 157:20,23 158:8 162:11 179:24 180:6 183:25 184:19 186:2 187:2 197:9 203:14 203:18 205:5,9 218:22,23 218:24 220:3,14 <b>managing</b> 23:9,15 <b>manipulative</b> 87:21	<b>manmade</b> 99:15 <b>manner</b> 19:7 23:7 26:7 27:7 <b>manufacture</b> 180:12 <b>manure</b> 29:8 46:15 50:16 64:15,20 69:1,11,18,25 77:16 82:25 83:1,4 93:24,25 94:10 95:16 96:7,10 97:7,19 97:21,24 99:5,9 100:14 103:3 110:4 113:22 114:21 115:15 116:10 144:20 145:11,12 147:10,11 149:4 149:21 150:5,13 154:9 155:7,10 167:16 168:14,20 169:14 181:13 182:1 185:6 188:2,3 189:6,12,19,21 191:15 192:7,8,11 214:25 215:7,10,16,17,25 216:3,6 216:15,15 217:8,13,15 <b>map</b> 135:23 155:22 <b>margin</b> 246:7 <b>margins</b> 194:2 <b>mark</b> 13:8,11 <b>marked</b> 57:21 92:16 107:10 133:10 152:15 165:16 196:17 214:15 <b>market</b> 194:2 <b>Maryland</b> 5:9,11 6:4 11:3 12:12,16 26:23 29:9 30:2 31:3,13 38:8,14 39:9 50:10 50:14,17,18,22 52:20 71:11 183:20 184:4,11,11 187:13 187:20 193:21,21 237:20 243:14,15,17 248:6 249:14 <b>mass</b> 102:13 <b>match</b> 210:15 <b>matched</b> 180:16 <b>material</b> 33:21 58:17 66:24 221:23 <b>materials</b> 57:11 58:1,9,12,14 58:19 66:24 89:3 107:25 163:14 214:17 <b>math</b> 175:11,12 206:3,8 207:4 209:12 210:11,16 212:8 223:9 <b>matter</b> 10:2 16:6 29:24 32:17
--	---	--



32:18 49:8 68:14 115:11 118:12,13 127:2 <b>maximal</b> 228:20 <b>maximize</b> 32:16 <b>maximizing</b> 32:17 <b>maximum</b> 6:19 20:15 63:22 64:3,4 65:23 113:19 138:24 <b>McCollum</b> 106:2 107:4 111:4 <b>McCollum's</b> 95:13 <b>McDaniel</b> 2:15 4:12,12 11:19 13:10,13 14:2 16:21,24 20:24 21:2,10,21 22:9 23:12 24:16 27:22 28:7 30:21 31:11 33:13 34:1,15 35:1,16 36:15 37:1,19 40:18,24 41:6 41:8,15 42:3 43:4 44:9 46:12 47:3,16,23 48:6 50:3 51:14,20,24 53:23 54:7,13 67:14 68:5,18 69:6 71:5 72:14,21 73:2 74:2,16,21 75:20 76:16 77:1,3,7 79:3,5 79:25 80:3 81:19 82:18 83:9 84:14 85:22 86:3,7 88:11 92:17 95:7 99:25 106:15,17 108:2 110:18 115:20,24 116:2 120:15 124:3 128:19 130:18 134:23 139:24 140:6,10 143:19,25 144:22 145:4,20,24 146:23 147:15,23 149:15 150:6,25 152:5 154:15,17 158:9 159:2,8,11,21 160:3,9,18 161:2,6,13,21 162:4,7,23 164:2,6,12,19 169:22 170:18 182:9,23 183:9 190:5 193:16 194:5,9,16,19 207:21 210:25 213:20 218:9 218:12 239:1,4,9 250:4 <b>mean</b> 11:6,19 15:4,5 16:14,20 18:14 19:2,8,10 22:11 36:4 37:15 38:20,24 42:5 60:5 63:20 73:10 78:22 87:25 89:11 96:8 97:10 101:23 103:7,25 105:9 111:13 113:23 114:11 118:7 120:25	121:4,21 122:14 123:17 136:7 141:1,11,19 142:3 156:11 158:1,4,13 160:11 170:2 171:1 188:10 189:13 189:14 191:19 192:14 203:2 216:21 219:11 220:5 224:24 225:3 226:18 227:11 229:14 230:14,20,21 231:2,17 245:9,23 <b>meaning</b> 7:14 32:15 116:10 144:5 158:2,3 159:25 <b>means</b> 12:17 14:19 16:25 37:18 111:23,25 113:12 120:3 137:19 149:19 154:5 157:4 161:9 185:5 203:3 214:23 227:9 234:18 237:7 241:8,19 <b>meant</b> 89:12 170:4 217:17 <b>measure</b> 83:24 156:24 157:1 229:14 <b>measured</b> 78:7 137:15 <b>measurement</b> 88:7 229:13 <b>measurements</b> 232:21 <b>measures</b> 185:4 186:13 <b>measuring</b> 88:3 <b>mechanism</b> 31:10 75:13 84:3 123:18 <b>mechanisms</b> 32:5 73:16 81:11 128:9 <b>medium</b> 151:6 219:1 224:1 225:16 226:4 227:21 228:13 230:14 234:11,18 236:10 237:11,24 238:12 247:9,10 248:4,19 249:5 <b>meet</b> 8:20 9:4 20:10,22 21:8 63:17 <b>meeting</b> 8:19 9:5,13 10:1 194:2 212:22 <b>meets</b> 64:18 <b>megagrams</b> 225:7,8,16 229:15 <b>Mehlich</b> 100:24 115:8,13 116:12,17 142:17 143:13 144:9 156:3 197:2 198:3,9 199:13 200:3 202:20 208:11	211:5 238:23 <b>memory</b> 140:9 <b>mental</b> 37:14,22 <b>mention</b> 89:23 <b>mentioned</b> 28:23 36:2 95:23 114:13 155:15 170:19 210:13 237:17 <b>mentioning</b> 56:25 168:25 191:7 <b>met</b> 8:14,24 <b>meters</b> 139:1,14 140:21 141:3 141:6,14 229:23 231:17,25 232:9,18 233:6,10,16 <b>method</b> 88:3 168:13,19 239:14,18 240:17 242:25 243:2 <b>methodology</b> 60:21 <b>methods</b> 82:5 242:20 <b>metric</b> 225:9,10,13,20,23 244:21 <b>micrograms</b> 199:17,23 211:6 <b>micronutrients</b> 16:5,11 <b>middle</b> 64:17,24 <b>midpoint</b> 95:11 <b>midway</b> 89:24 102:24 203:8 <b>miles</b> 1:6 134:4 <b>milligram</b> 225:11 <b>milligrams</b> 100:25 101:9 142:25 143:13 144:9 199:14 199:18,21 225:6 248:12 <b>million</b> 101:1 199:19,20 200:15 201:23 206:25 207:9 207:15,20 208:1,8,11,12,21 209:14,20,23 238:23 <b>mind</b> 121:23 159:3 188:16 205:17 <b>Mine</b> 230:12 <b>mined</b> 190:10,14,18 <b>mineral</b> 16:6 <b>mineralization</b> 118:3 <b>minimal</b> 228:19 <b>minimize</b> 6:21 149:12 154:11 <b>minimizing</b> 149:1 <b>minor</b> 169:13 <b>minute</b> 13:9 41:15 63:3 69:16
--	--	--



<p>72:9 91:23 172:1 180:5 200:25 209:19 211:24 224:14 237:1 <b>mischaracterizes</b> 84:15 <b>misleading</b> 144:23 <b>mission</b> 11:10 <b>misspeak</b> 24:21 <b>misspoke</b> 49:2 <b>mixed</b> 17:1 <b>mixture</b> 16:19,20,25 17:1 18:23 <b>model</b> 119:9,15 120:21 121:14 122:1,6,8,9,12,16,17 122:18,20,21 197:13,17,23 199:7 200:8,11,19,21 205:15,21 216:11 245:14 <b>modeler</b> 121:23 197:18 204:15 <b>modelers</b> 197:18 217:18,20 217:24 <b>modeling</b> 121:24 199:8 201:13 202:10 203:15 204:1 204:5 205:6,20,23 211:16 216:12 217:6 <b>models</b> 121:25 195:16,23 197:7,15 198:2 204:12,14 205:12 217:7 <b>modified</b> 156:23 220:15 <b>moment</b> 92:15 109:10 155:23 165:1 176:24 195:6 202:14 207:14 234:5 <b>money</b> 41:13 186:24,25 187:20 <b>monitoring</b> 136:12 <b>months</b> 240:20,21,22 241:19 241:23,25 242:3 <b>Moore</b> 58:21 59:6 <b>moral</b> 161:23 <b>morally</b> 161:19 <b>move</b> 9:17 27:5,9,10,11,15 43:2 54:5 66:25 73:12,14,17 74:21 91:3 123:19 127:22 129:10 150:7 189:9 190:16 190:18 232:9 <b>moved</b> 28:1 45:25 50:6 52:5</p>	<p>127:18 128:25 147:24 190:20,25 191:1,22 <b>movement</b> 67:1 85:17 128:17 <b>moves</b> 74:5,8 98:21 126:17 128:6 <b>moving</b> 27:23 28:14 50:1,14 50:23,25 51:2,19 52:10 73:5 73:8 83:23 126:2 131:13 146:11 188:3 189:12,19,21 190:2 221:25 <b>mud</b> 131:22,25 <b>muddy</b> 131:20,21 <b>multiple</b> 40:19 49:12 82:10 <b>multiply</b> 245:19,22 247:18 248:7 <b>Multiplying</b> 247:24 <b>M3P</b> 114:18</p> <hr/> <p style="text-align: center;"><b>N</b></p> <hr/> <p><b>N</b> 2:1 3:1,3 17:7,11 63:2,9,17 109:12 113:7,8,9 154:11 168:3 <b>name</b> 5:5 48:14 73:20 92:21 107:20 136:25 152:20 226:22 <b>named</b> 253:9 <b>names</b> 9:9 136:25 <b>Nance</b> 2:3 3:5 4:7,7 5:4 11:21 13:12,15 16:23 25:7 41:7 44:19 48:4 57:22 62:9 67:17 71:7 84:18 95:8 106:13,16 123:1 139:21 145:22 152:8 194:15,18,24 207:23 213:21 239:2,11 250:25 <b>national</b> 153:11,17 <b>native</b> 66:21 67:13 68:22 <b>natural</b> 1:7 99:15 166:3 <b>naturally</b> 128:23 129:20 <b>nature</b> 56:11,13 166:9 <b>near</b> 66:5 137:20,23,23 138:5 138:15,21 142:4 148:7,9,12 <b>nearer</b> 138:11 <b>nearly</b> 142:21 <b>nearness</b> 139:5</p>	<p><b>near-stream</b> 137:18 <b>necessarily</b> 16:1 38:24 131:25 174:9 215:20 <b>need</b> 7:18 15:13,23 20:3,3,8 20:10,23 21:8 22:15 23:20 23:23 29:19,22 33:12,19,20 33:24 42:15,21 43:7,8,19,22 44:15,17 47:6 62:20,20 67:15,18 97:12 99:21 110:6 113:18 115:20,21 117:14 137:9 151:23 169:1 184:23 205:2 206:15 223:15 243:21 <b>needed</b> 31:1 41:4,25 43:15 45:7 52:18 150:14 183:22 184:9 <b>needs</b> 15:6,10,18 20:15 21:16 22:6,13 32:25 33:7 43:3,10 45:14,15 52:5 63:17 64:3,19 65:3 113:17 183:4 244:17 <b>negligible</b> 37:5 43:13 226:18 226:22,23 227:13 <b>negotiated</b> 53:1 <b>neutral</b> 161:19 <b>never</b> 25:4 52:6 78:11 87:8 136:22 139:16 210:13 <b>new</b> 90:25 193:13 <b>nine</b> 154:21,22 155:3,5 <b>nine-tenths</b> 176:1 <b>nitrogen</b> 9:15 15:14,18,20,23 15:25 17:12,19 18:20,21 19:15,22 20:3,7,8,10,14,23 21:8,16 22:6,12 23:17,21,23 29:20,22 32:15,24 33:4,12 33:19,24 41:4,25 42:21 43:3 43:7,7,8,10,15,22,25 45:7,8 45:14,19 46:4,7,9 47:2 54:20,24 55:5,10,16 62:12 62:20,24 64:2,3,5,6 65:2 66:15 68:15 94:11 96:6,13 113:18,21,23 150:14 155:2 155:12,14 174:9 183:5,22 184:8,24 <b>nitrogen-based</b> 64:16 <b>nitrogen-supplying</b> 55:14 <b>nonexistent</b> 119:24</p>
--	---	--

**normal** 57:16 64:15 87:22  
**north** 2:20 17:3  
**NORTHERN** 1:2  
**Notary** 252:21  
**note** 244:12  
**notes** 253:12  
**notice** 13:20 232:14  
**notion** 26:10  
**November** 7:20 8:8  
**NO3** 154:13  
**NRCS** 221:12  
**number** 38:21 50:21 57:23  
     79:13,14,15 108:11 120:10  
     133:21 167:1 169:17 170:9  
     170:10 178:5 206:15 212:11  
     221:22 222:19 224:17  
     236:11 245:16 247:22 254:3  
**numbered** 1:17 109:7 252:6  
**numbers** 156:6,11 176:21  
     209:12 211:11 230:16  
     236:15,21 238:2 239:25  
     240:13 243:10 244:16  
**numerical** 38:19,21,23 39:2  
     226:3,7 227:7 229:13  
     236:23 237:14  
**numerically** 38:17,24 60:25  
**nutrient** 6:11 8:21,22 11:12  
     14:24 15:1,7,8,9,11,22  
     33:20 46:18 47:5,7 53:12  
     54:15 62:13 88:8 95:17  
     161:12,16 183:25 184:18  
     188:19 218:22 221:2  
**nutrients** 6:17,19,22 7:7 9:15  
     9:17,19 18:10 32:19 33:19  
     44:7 73:17 134:3,21 135:5,9  
     135:11 186:19 191:14  
**nutrition** 71:23  
**N-based** 155:9  
**N-P** 109:11 155:7  
**N.E** 2:6

---

**O**

---

**O** 2:23  
**object** 20:24 21:21 22:9  
     23:12 24:16 27:22 28:7

    30:21 31:11 33:13 34:1,15  
     35:16 36:15 37:1 40:18  
     41:8 42:3 43:4 44:9 46:12  
     47:16 48:6 50:3 51:14,20  
     53:23 54:7 67:14 68:5,18  
     72:14,21 73:2 74:2,16 75:20  
     76:16 77:1,3,7 79:3,5,25  
     80:3 81:19 83:9 84:14  
     85:22 86:3,7 88:11 107:4  
     110:18 120:15 124:3 128:19  
     130:18 134:23 143:19  
     144:22 145:4,20 146:23  
     149:15 150:6,25 154:15,17  
     158:9 159:2,8,11,21 160:18  
     161:2,6,13,21 162:4,7,23  
     164:2,6,12,19 169:22  
     170:18 182:9,23 183:9  
     190:5 193:16 250:4  
**objection** 21:10 35:1 40:24  
     47:3 51:24 54:13 147:16,23  
     160:9 194:5,9,9,20  
**observation** 140:24,25 142:8  
**observed** 103:1 138:25  
     139:19  
**obtained** 96:7  
**obviously** 94:1 154:18 230:20  
**occasion** 6:6  
**occur** 169:4 230:25  
**occurred** 82:22  
**occurring** 128:23 129:20  
     175:6  
**offer** 9:24 11:9 18:6 52:24  
     56:6 59:20,24  
**offered** 10:13 40:7,10 43:21  
     134:24 159:12 193:17  
     194:10  
**offering** 10:14 59:16  
**office** 8:15  
**oftentimes** 29:21 89:12 91:5  
     126:4  
**oh** 18:3 100:3 101:8 136:18  
     156:12 163:18 165:24 211:2  
     237:8 246:20  
**OK** 2:4,7,11,17  
**okay** 6:3,6,14 7:9,12,21 8:5

    9:7,12 13:10,20,24 14:10,19  
     15:4 16:16 17:18 18:5,8,14  
     20:2 21:11,23 22:1,5,21,25  
     24:10,24 27:15 28:25 29:24  
     31:8 32:11 33:9 34:12  
     35:14 37:23 38:3 39:7,14,15  
     40:13 41:2,11,14 42:4,8,17  
     43:1 45:11,17,25 46:8 51:8  
     55:3,22 56:1,5,8,19,25 57:7  
     57:20 60:9,12 61:7,14 62:5  
     62:7,25 65:7 66:15 69:24  
     70:4,14,18 71:21 72:9 73:10  
     73:20,22 74:13 75:4,10,13  
     75:24 76:24 77:5,9 81:1,11  
     81:14 83:19 85:25 86:14  
     87:2,12,16 88:8,15,19 89:19  
     89:22,22 90:1,13,20 91:10  
     91:17,23 92:7,14 93:17 94:1  
     94:9,20,23 95:10,20,24 96:2  
     96:24 98:2,10,13 99:4,17,23  
     100:5,21,23 101:2,7,15  
     102:2,16,20 103:12,15  
     104:16,25 105:23 106:7,12  
     107:6,16,20 108:1,20 109:6  
     109:22 110:11,15,22 111:6  
     111:16 112:7,23 113:5,10  
     113:24 114:14 115:15,23  
     116:1,9,23 117:23 119:4  
     120:20 121:16,20 122:25  
     124:8 125:9,11,25 127:10  
     127:24 128:4,9 129:20  
     130:11,23 131:2,6,10,21,25  
     134:13,14,19 135:21 136:14  
     136:20 137:3,8,13 138:1,13  
     139:9 140:14,20 141:5,25  
     143:9 144:3 146:2,22 147:2  
     147:14,23 148:4,11 149:18  
     149:24 150:3,21 152:4,19  
     152:23 153:1,11 154:5,8,20  
     155:7,21 156:18,21 157:5,9  
     157:19 158:20,25 159:18,23  
     163:21 165:1 166:14,15,19  
     166:24 167:3,14,22 168:1  
     168:10 169:3,9 171:17  
     172:7,9,10,13 173:7,15,19

173:24 174:2,11 175:13,15 175:25 176:11,20,23 177:8 177:12,17,20 180:4,15,24 181:11,25 183:3,6,19 184:7 186:1,7,10 187:23 188:25 189:6,25 191:9 192:6,25 194:19,24 196:1,2,12,16,18 196:22 198:7,17 199:5,18 199:20,22,24 200:14,22 201:16 203:4,12 205:1,13 205:24 206:1,21,22 207:6 207:13,18 208:3,5,18,19 209:3,5,9,14,25 210:12 211:12 212:4,7,10,13,16 213:12,18 214:15,22 215:5 216:5,8 218:11,17 219:21 220:17,23 221:19 222:23 223:3,11,20,25 224:3,13,17 225:23 226:1,18,24 229:12 229:24 230:10 231:6,21,22 232:14 233:4,8,14,21 234:22 235:1,10,13 236:7 236:25 237:8,11,20 238:5 238:11,14,20 239:4,8,24 240:4,17 241:12,17 242:7 242:20 243:9,13,17,24 244:19 245:1,5,15,25 246:17,20 247:2,7,11,18,21 248:6,11,18 249:7,16,19 250:25 <b>Oklahoma</b> 1:2,5,6,8,19,22 2:7 4:8,10,11 47:6 86:12 88:20 101:6,12 161:15 171:21 172:9 184:15,22 206:22 220:18,21 221:3,6 221:12 238:24 239:1,3,7 248:14,17 250:16 253:3,8 <b>Olsen</b> 57:11,18 132:4 <b>Olsen's</b> 132:11 <b>omitted</b> 194:22 <b>once</b> 5:19 38:20,21 84:2 95:16 126:2 187:21 192:15 223:13,21 231:2,12,24 <b>ones</b> 39:25 48:17 108:16 <b>one-fifth</b> 247:14	<b>one-third</b> 167:14 <b>on-campus</b> 11:5 <b>open</b> 123:22 159:16 165:5 <b>operating</b> 192:4 <b>operation</b> 23:5 50:12 182:15 186:17 188:20 192:21,21 <b>operations</b> 49:15 70:15 147:5 167:8,10 188:1,11 189:1 191:18 192:13 193:2,3 <b>opine</b> 132:25 <b>opinion</b> 29:25 30:9 54:8 56:6 92:8 120:11 160:21 212:15 213:1 249:12 <b>opinions</b> 13:6 134:24 159:12 193:17 194:10 <b>opportunity</b> 212:24 <b>opposed</b> 138:11 <b>oppressive</b> 83:13 <b>optimum</b> 106:1 109:18 162:11 238:15,24 248:19,23 248:25 <b>option</b> 29:2,14 96:21 114:6 <b>options</b> 26:4,5,6 28:24 96:18 96:19 112:25 113:6 <b>order</b> 68:9 123:11 217:1 <b>ordered</b> 41:19 <b>orders</b> 42:18 <b>organic</b> 16:6 65:10,12 118:12 118:13 126:5 127:2 169:4 239:16,17 242:7,14 246:2 246:18,22 <b>organize</b> 235:3,8 <b>oriented</b> 203:1 <b>origin</b> 68:23 <b>original</b> 67:24 68:20 83:25 <b>originally</b> 58:4 84:5 190:19 <b>originate</b> 138:14 <b>originated</b> 76:14 82:23 83:18 84:5 <b>originates</b> 43:6 74:14 <b>ought</b> 171:7 <b>outcome</b> 35:21 37:4,8 151:4,8 220:10 243:23 <b>outlet</b> 126:7 <b>outlined</b> 82:14 128:20 178:12	178:21 <b>output</b> 36:19 37:12 38:17,23 39:8 153:7 <b>outputs</b> 181:6 <b>outside</b> 32:22,24 33:2,3 88:12 88:14 98:25 134:24 159:12 159:22 163:11 193:17 194:10 235:15 250:6 <b>out-of-watershed</b> 32:16 45:12 <b>overall</b> 19:24 35:18 40:1 157:22 158:4 169:3,9 170:17 171:14 188:1,9 197:1 <b>overcome</b> 185:7 187:25 <b>Overcoming</b> 179:23 <b>overgeneralization</b> 166:12 <b>overland</b> 123:21 <b>overlies</b> 132:19 <b>overlooked</b> 246:9 <b>override</b> 39:23,24 <b>overriding</b> 196:3 <b>overview</b> 6:9,10 99:7 211:16 <b>overwhelm</b> 39:18 <b>owners</b> 61:4 <b>owns</b> 45:18 182:17
<hr/>		
<b>P</b>		
<hr/>		
<b>P</b> 2:1,1,23 3:3 17:7,7,14 30:25 31:1,2 39:19 56:14 63:8 65:9,10,12,13 85:9,15 85:16 87:4 89:9,13 90:3,14 90:24 91:7 94:17,25,25 95:15 96:10,18,20 97:3,6,9 100:16,19,24,25 101:18,20 102:25 103:2,17 105:4,6,14 105:19,25 107:1 108:10 109:12,16 110:2,3,19,21,25 111:11,11,16,21 112:4,5,7,9 113:7,9 114:3,8,18,20,20 115:8,8,8,12,13 116:17,20 116:24,25 117:8,9 118:2,2,4 118:15,23 119:5,14,17 120:12,12 123:11,14,15 127:17,20 128:4,24 131:5,6		

<p>131:8,11,12 133:8 138:24  141:8 142:17,22,24 143:11  143:14,14,15,18,22 144:4,9  144:10,11 145:18 146:3,8  146:11,20 147:3 148:6,7,11  148:14,18,21,22 151:7  153:6,12 155:10,17 156:3  157:6,20,22,23 158:4  162:13 166:2,10,22,25  167:10,14 168:2,4,13,19  169:4,5,10,14 173:7,13  174:20 175:6 180:6,16  185:15,20 191:15,16 192:10  193:3 195:18,19,19,25,25  197:5,7 199:13 201:8 202:8  202:25 203:9,12,17,17  205:3,8,8,14 208:7,10  209:14 210:22 211:5 214:1  214:2 215:5,9,14,15,18,21  215:22 216:7,13 220:5,13  220:19,21 223:22 227:2  235:7 237:2,4 238:23  239:13,14,16,17,22 242:9  246:9,14 247:6 248:1  <b>package</b> 58:9,12  <b>page</b> 3:7 14:13,15 16:16  22:22 54:18 56:8,8 63:1,12  65:7 69:9 85:10 87:2 89:25  93:7,8 95:11 96:24,24 99:17  99:18 101:15 102:23 103:12  104:25 105:24 109:6,22  111:6,7 114:15 117:12,19  117:20,21,22 123:9 132:3  132:10 133:21,22 135:21  137:8 142:14 153:3 155:21  155:22 156:18 164:20 165:5  166:14 168:13 169:10  171:17,18 177:12,12 180:2  195:7 196:23 198:24 205:25  211:3 212:17 218:2,15  220:18 222:24 249:9 252:1  254:3  <b>pages</b> 253:17  <b>paid</b> 51:3,3 79:13 86:25  <b>panacea</b> 26:3</p>	<p><b>Pant</b> 110:5  <b>paper</b> 119:25 120:1 157:11  169:25 195:21,22 196:19,23  210:7 216:14  <b>paperwork</b> 187:17  <b>paragraph</b> 14:15 16:2,3 57:7  85:8 87:2 89:9,23 90:21  92:18 95:10 96:17,25  102:24 103:12 104:6 105:23  109:23 111:2 112:23,24  133:23 137:12 142:15 145:7  147:14,18,20,20,25 148:2  148:11 152:17 155:16  156:19 180:6 185:2 191:13  192:6 193:1,11 195:7,9  202:19 203:7,7 206:10  208:7,23,24 211:3 214:23  218:2,6  <b>paragraphs</b> 212:25  <b>parameters</b> 122:2  <b>paraphrase</b> 16:21  <b>Pardon</b> 13:9  <b>parentheses</b> 210:21  <b>parenthesis</b> 109:13 236:22  244:16  <b>part</b> 6:24 11:8 20:21 21:6  23:7 27:12,12 50:20 51:5,6  54:10,11 57:15 58:9,18 68:1  83:19 84:2 89:8,24 111:16  111:21 116:11 139:8 145:7  150:3,7 154:4 155:22  164:22 165:6,8,10 176:8  187:4 188:24 201:15 220:5  220:12  <b>partake</b> 204:18  <b>participate</b> 187:15  <b>participated</b> 92:15  <b>particles</b> 112:6 131:13  <b>particular</b> 15:7 18:2 78:2  126:10 132:21,24 139:10  204:18 219:15 224:6 235:7  <b>particularly</b> 62:16 65:20  66:20 143:12 144:8  <b>particulate</b> 75:11 131:6,7,12  131:14</p>	<p><b>parties</b> 253:20  <b>partition</b> 197:23  <b>partitioning</b> 197:25  <b>partly</b> 145:2,2  <b>parts</b> 21:14 100:25 199:19,20  200:15,15 201:22,23 206:24  207:9,9,15,15,19,20 208:1,8  208:9,11,12,14,20 209:14  209:20,22,23 213:4 238:23  <b>party</b> 29:11 51:3,4  <b>pasture</b> 20:14,14 33:10,23  34:3 43:5,8,23 62:13,21,22  63:9 69:12 98:4 107:19  114:21  <b>pastureland</b> 60:15 61:3 102:8  <b>pastures</b> 24:13 54:20 63:2  102:6,17 166:3  <b>pasture-grazed</b> 55:7 62:16  <b>path</b> 125:1  <b>pathway</b> 123:17,20,22 124:2  124:9,17,20 129:13  <b>pathways</b> 123:14 166:4 169:6  <b>patterns</b> 148:6  <b>pay</b> 31:3 41:12,19 42:19 52:6  53:2 144:16 193:12,15  194:4  <b>peaty</b> 169:4  <b>Peninsula</b> 6:7,16,24 7:2,24  8:3  <b>Penn</b> 143:3 156:8 237:17  <b>Pennsylvania</b> 135:15 143:5  223:6,13 227:2 228:11  233:18  <b>people</b> 9:9 20:22 21:7 26:14  26:17 27:4,5,8 56:17 57:3  60:5 95:2 134:7 160:16  187:15 197:18 243:6 250:12  250:14  <b>people's</b> 244:18  <b>peppermint</b> 133:18  <b>perceive</b> 180:20  <b>percent</b> 72:5 80:9 103:19,19  103:21 104:4 134:3,4  142:21 143:7,12 144:5,8  166:2,6,11,22 168:2 169:15</p>
---	---	--

169:17,20,21 170:5,13 171:15 178:5,9,19 197:21 197:22 <b>percentage</b> 50:21 68:21 132:16 167:21 <b>percentages</b> 60:4 <b>percolation</b> 132:20 133:1 <b>period</b> 103:3,17 176:7 224:10 224:14 230:10,17,20 231:2 234:4,6,19 235:4 244:10,13 245:5,13,15,20 249:13 <b>permits</b> 55:6 <b>personal</b> 50:7,9 142:7 <b>personally</b> 22:1 31:21,24 47:10 222:3 <b>personnel</b> 11:14,14 <b>perspective</b> 49:21 138:23 170:5,21 178:14 <b>perspectives</b> 105:1 149:19 <b>pertinent</b> 10:7 208:7 213:4 <b>pervasive</b> 155:3 <b>Peterson</b> 2:15 4:12 <b>pH</b> 127:1 129:17,23 130:3,8 <b>phase</b> 71:22 <b>phases</b> 118:11 126:25 <b>PhD</b> 1:15 3:4 4:24 48:9 252:3 252:12 254:1 <b>phone</b> 2:24 4:19 8:10 <b>phosphate</b> 190:14,24 <b>phosphoric</b> 56:23 57:4 <b>phosphorus</b> 9:15 10:16,16,24 11:3,16 12:12,16 17:14,20 17:20 18:20,21 19:15,22 20:4,12,16,17,18,23 21:9,17 22:7,14 23:18,21,24 29:20 29:22 30:11,17 31:16 32:15 32:25 33:5,12,20,25 35:7,17 35:20,22 36:3,17,24 37:3,4 37:6,7,8,13 38:8,15,17 39:1 39:16 41:4,25 42:22,25 43:3 43:11,13 44:3,15,17 45:14 45:23 46:1,2,9,20 47:2 49:4 54:1,12 56:10,13,24 57:4,5 59:17 62:21,24 64:19 65:25 66:1,4,8,11,19,23,24,25	67:10,24,25 68:7,10,10,11 68:13,16,21,22,23 69:1,11 69:17,24 70:2,5,6 71:4,17 72:3,10,18 73:5,7,25 74:7 74:11,13 75:7,9,11,24 76:4 76:7,8,14,21,23,25 77:13,17 77:20 78:8 81:12,17,21,23 82:3,6,10,16,21 83:6,17,19 83:20,20,24 84:1,2,5,8,11 85:4,12 87:13 88:1,2,5,6,8 89:13,16,20,20 90:25 91:18 93:13,23 97:15,15,17,21 98:8,11,12,14,19,22,22,24 99:6,20 103:11 105:11,12 105:16 108:10,23 109:2 110:10 111:19,25 112:3,5 112:20 113:14,20,22 114:1 114:5 118:8,9,12,16,19,20 118:22 119:1 120:6 121:6 123:19 124:2 125:20,22 126:3,17,19,19 128:6,18 129:4,5,7,14 130:1,16 131:15 135:11,13 137:11 138:14,19,20 139:4 143:16 146:14 149:2,8,14 150:1,17 150:23 151:3,12,15,20 155:4,12 156:16 157:13 158:5,12,17,19 159:10 162:2,14,22,25 163:6,8,13 163:19,22,25 164:11 167:8 168:1,10 169:2,11 172:3,7,8 172:23 173:5,21 174:3,10 174:11,12 176:9 179:8 180:15,21 181:5,6,17 183:5 183:21 184:8,12,24 185:21 190:6,7,7,9 191:3 197:2,4 199:15 216:2,18,19 217:1 218:20,21 219:2,3,11,17,17 219:19,21,25 220:23 221:19 222:4,17 223:3,5,7 224:6 236:5 237:25 238:22 239:23 241:8 242:15,16 247:21 248:10 249:8 250:2,9,17,18 <b>phosphorus-based</b> 63:24 64:18 179:24	<b>phrase</b> 155:1 <b>phrases</b> 121:1 <b>ptyoremediating</b> 113:16 <b>physical</b> 78:20 100:6 121:2 124:25 128:12,16 130:14 131:8,11,12 185:21 <b>physically</b> 83:22 118:10 <b>phytoremediation</b> 91:11,18 101:23 106:25 113:14 120:14 <b>phytoremediation-type</b> 107:15 <b>PI</b> 14:8 58:11 156:23 184:20 228:6 243:25 245:14 <b>pick</b> 118:22 201:14 <b>picking</b> 115:3 177:7 <b>picks</b> 166:7 <b>pictures</b> 168:16 <b>piece</b> 115:18 117:4 124:8 219:2 <b>pieces</b> 145:22 188:8 <b>piles</b> 117:16 <b>pipeline</b> 151:11 <b>place</b> 18:21,21,22 25:20 27:6 34:24 36:13,25 100:9 106:13 122:13 126:6 147:12 150:20 182:21 183:4 190:8 240:17 251:1 253:18 <b>placed</b> 241:7 <b>placement</b> 245:8 <b>places</b> 90:23 183:21 228:3 235:11 <b>Plaintiff</b> 1:9,16 <b>PLAINTIFFS</b> 2:3 <b>Plaintiff's</b> 13:8 14:10 57:21 <b>plan</b> 28:11 46:18 47:5,7 85:6 183:25 184:1,2 <b>planned</b> 250:24 <b>planning</b> 191:17 218:22 220:6 <b>plans</b> 27:2,9 <b>plant</b> 14:24 20:3 66:6 67:24 68:22 71:18 113:8 <b>planted</b> 241:14 242:1 <b>planter</b> 240:18 241:7
--	--	--



<p><b>planting</b> 116:11</p> <p><b>plants</b> 14:25 15:13 55:1 68:11 69:12 83:21 91:14 98:17 113:16 118:21 119:2 242:5</p> <p><b>plant-available</b> 54:20 64:2</p> <p><b>plausible</b> 30:19</p> <p><b>play</b> 194:8</p> <p><b>played</b> 129:15</p> <p><b>playing</b> 194:7,12</p> <p><b>Plaza</b> 2:23</p> <p><b>please</b> 4:6 5:6 21:4 39:13 67:19 69:4 91:13 94:24 97:12 111:14,15 114:25 135:17 140:12 195:11 212:20 223:19</p> <p><b>plenty</b> 204:24 216:17</p> <p><b>plot</b> 137:16 178:24,25 201:3</p> <p><b>plowed</b> 241:15</p> <p><b>plug</b> 67:18</p> <p><b>plugged</b> 244:20</p> <p><b>plugging</b> 207:19</p> <p><b>Plus</b> 159:21</p> <p><b>point</b> 10:23 15:16 24:8 28:15 29:13 33:16 52:5,5 83:15 88:2 119:21 121:12 124:13 124:24 125:2 152:5 161:23 162:13 166:4,13 167:24 169:25 170:12 183:15 189:14 196:3 197:14 202:2 202:4,6 207:25 208:6 217:4 217:10 218:20 228:20</p> <p><b>pointing</b> 211:1</p> <p><b>points</b> 198:15 228:9</p> <p><b>policy</b> 53:5 56:17 193:19,22 193:24 245:9</p> <p><b>political</b> 193:24</p> <p><b>pool</b> 83:19,21 84:3 118:8,9</p> <p><b>pools</b> 118:18 120:6</p> <p><b>population</b> 11:15</p> <p><b>porosity</b> 132:18</p> <p><b>portion</b> 101:16 102:16 157:11 246:25</p> <p><b>portions</b> 149:5 150:17</p> <p><b>position</b> 26:4 60:24</p>	<p><b>positive</b> 115:7,11</p> <p><b>positively</b> 116:25 117:8</p> <p><b>possible</b> 30:16 72:22,24 110:20 113:15 114:4 179:18 180:16 195:12 204:16</p> <p><b>possibly</b> 186:19,22</p> <p><b>pot</b> 197:21,22,22</p> <p><b>potassium</b> 17:16,21 18:19,20 19:23 96:6,14</p> <p><b>potential</b> 15:7,9 34:2 37:9 39:15 45:13 85:17,19 87:4 112:9 132:21 133:8 138:24 143:21,24 144:12 148:14,17 148:18,22 149:7 202:24 219:18,20 221:21,25 227:16 229:4,5</p> <p><b>potentially</b> 70:1,3,7 72:22,23 96:14 124:12</p> <p><b>poultry</b> 11:17,23 16:18 17:19 18:10,12,17 21:13 28:18,19 33:10,21,22 44:7 50:1,10,13 50:20 52:2 53:1 54:19 55:3 57:9,16 63:14,18 69:21 70:2 70:9 71:3,6,7,10,23 72:11 72:12 73:13 74:14,22 75:19 79:2,9 85:4 87:9,17 89:20 94:5 98:5 154:1 160:8 166:2 167:8,10,15 172:3 179:24 180:8,11,11,17 181:4 182:17 185:6 187:25 188:1,11,25 191:18,22 192:12,19,21 193:2 221:2</p> <p><b>pound</b> 73:12 84:6 90:5 121:10 221:6</p> <p><b>pounds</b> 19:22 73:14,14,18 84:7,7 90:6 101:3,5,13 119:19 120:9 121:7 169:13 206:16,23 226:1 238:25 240:8 248:14,16 249:3</p> <p><b>PowerPoint</b> 58:4,7,13 59:12</p> <p><b>PPB</b> 210:22</p> <p><b>PPM</b> 210:21</p> <p><b>practical</b> 24:7 49:16 96:18,21</p> <p><b>practically</b> 119:24</p> <p><b>practice</b> 29:15 31:15 47:9</p>	<p>49:15 71:12 72:4 97:7 111:24 139:15,19 149:9 150:8 186:2 187:2</p> <p><b>practices</b> 31:20 186:3 203:14 205:5 220:3,14</p> <p><b>precise</b> 211:15,18,21 212:5 212:10</p> <p><b>precisely</b> 204:18</p> <p><b>precision</b> 212:14</p> <p><b>preclude</b> 51:17</p> <p><b>predict</b> 122:21 202:7 214:2</p> <p><b>predicted</b> 35:22 108:18 122:8 122:11,15 215:14</p> <p><b>predicting</b> 205:14</p> <p><b>prediction</b> 104:10 195:23 207:8,11 210:20 217:16</p> <p><b>predictive</b> 122:21</p> <p><b>predictor</b> 88:5</p> <p><b>predicts</b> 122:20</p> <p><b>preface</b> 87:19</p> <p><b>prefer</b> 24:19</p> <p><b>preferential</b> 169:6</p> <p><b>prehistoric</b> 190:11</p> <p><b>preliminary</b> 5:19,20 10:10,21 12:5,9,25</p> <p><b>premise</b> 76:19 121:14 220:25</p> <p><b>preparation</b> 12:4 59:13 86:9 86:10</p> <p><b>prepare</b> 10:20 132:25</p> <p><b>prepared</b> 13:3 72:24 124:6 135:1</p> <p><b>presence</b> 8:1,2</p> <p><b>present</b> 9:9 219:19</p> <p><b>presentation</b> 121:9</p> <p><b>presented</b> 14:21 57:11,13 119:15 157:11 209:1 210:3 210:7 212:5 227:1 252:4</p> <p><b>presenting</b> 210:9</p> <p><b>presumably</b> 176:10 232:6 234:8</p> <p><b>presume</b> 8:16 115:6 173:18 174:14 237:16</p> <p><b>presumption</b> 216:10 243:5</p> <p><b>pretreatment</b> 109:1</p> <p><b>pretty</b> 25:7 28:16 54:23</p>
---	---	--



<p>223:10 238:9</p> <p><b>previous</b> 67:21 117:19</p> <p><b>previously</b> 96:7 115:5 148:5 197:17</p> <p><b>primarily</b> 137:17</p> <p><b>primary</b> 20:7 53:13 54:19</p> <p><b>principle</b> 181:20</p> <p><b>principles</b> 10:24</p> <p><b>printed</b> 58:6 225:1</p> <p><b>prior</b> 5:24 7:24</p> <p><b>proactive</b> 114:22 116:14</p> <p><b>probability</b> 15:24</p> <p><b>probably</b> 7:17 10:3,6 59:4,15 64:6 66:17 71:13 86:21 89:5 105:24 110:13 112:2 113:21 134:8 143:3 154:22 162:9 166:7 171:8 174:8 178:13 179:1,1,2 183:16 189:4 196:15 205:12 237:17</p> <p><b>problem</b> 6:23 7:1 20:21 21:6 25:14 48:2 134:1,9 140:12 157:14 159:4,6,9,18 160:5 162:2,6 177:23 180:20 181:16 210:9,16</p> <p><b>procedure</b> 84:3</p> <p><b>proceedings</b> 44:25 84:23 106:21 152:12 195:3 234:1 252:6</p> <p><b>process</b> 84:4 116:11 127:4,7 150:9,12 182:20,24 212:14 218:22 220:6</p> <p><b>processes</b> 126:20 127:9</p> <p><b>produce</b> 6:19 153:7 193:14</p> <p><b>produced</b> 1:15 23:5 42:24 43:18 88:23 89:2 90:22 97:2 153:20 190:9 192:17</p> <p><b>producer</b> 45:5 46:1 113:6</p> <p><b>producers</b> 60:1,4 192:11</p> <p><b>producing</b> 46:6,15,17 60:22 108:8 138:25 148:12 192:2</p> <p><b>product</b> 18:11 19:1,4 28:19 44:8 245:22</p> <p><b>production</b> 4:18 6:13,15,19 6:25 9:16 16:4 30:14,15 31:14 55:6 62:17 71:10</p>	<p>93:21 95:12 100:9 105:5 109:4,4 150:8 154:10 157:16 180:11 187:25 188:4 189:13,20 191:22,24 192:16 192:19</p> <p><b>productivity</b> 20:15 63:10 64:3,4</p> <p><b>products</b> 180:17</p> <p><b>profess</b> 232:12</p> <p><b>profession</b> 21:19 49:24 51:8 51:23,25 52:4,8 53:7,12 54:14,15 75:15 134:8 140:20 151:12</p> <p><b>professional</b> 22:8,10,16 26:9 29:24 31:25 160:21 183:1 228:17 229:7 243:7,19</p> <p><b>professionally</b> 49:4 50:6 52:14 59:3 163:2 179:15</p> <p><b>professionals</b> 26:25</p> <p><b>profession's</b> 54:11</p> <p><b>professor</b> 5:9 58:25</p> <p><b>profit</b> 188:18</p> <p><b>profitability</b> 188:15 194:2</p> <p><b>profusely</b> 66:7</p> <p><b>program</b> 29:8 50:16,16 51:5 187:9</p> <p><b>programs</b> 187:7,12,13</p> <p><b>progress</b> 130:16</p> <p><b>progression</b> 234:14</p> <p><b>projected</b> 218:23</p> <p><b>promise</b> 223:12 238:20</p> <p><b>promising</b> 156:7</p> <p><b>prone</b> 24:5 126:24 241:11</p> <p><b>proneness</b> 24:5</p> <p><b>pronounce</b> 92:21 152:20 222:20</p> <p><b>pronounced</b> 58:24</p> <p><b>properly</b> 162:25 213:2,7</p> <p><b>properties</b> 157:7</p> <p><b>property</b> 27:14 28:9 29:1 42:11,13,15 43:15 55:12,18 151:9 181:18</p> <p><b>proportion</b> 169:13</p> <p><b>proposal</b> 163:24 164:4,9,15 193:14</p>	<p><b>proposed</b> 56:3 156:23 164:13 165:25</p> <p><b>proposing</b> 189:18</p> <p><b>proposition</b> 21:18 72:18 169:15 228:6</p> <p><b>protect</b> 27:24</p> <p><b>protective</b> 186:21</p> <p><b>protocol</b> 132:7 179:15,16,17 179:20</p> <p><b>proves</b> 28:12</p> <p><b>provide</b> 180:12 183:1</p> <p><b>provided</b> 58:18</p> <p><b>provides</b> 157:5</p> <p><b>proximity</b> 7:11</p> <p><b>pseudo</b> 170:3</p> <p><b>public</b> 11:10,10 171:6 193:13 193:15,19,22 252:21</p> <p><b>publication</b> 12:19 107:18 134:15 207:8 210:21 222:11 226:22</p> <p><b>publications</b> 12:20 195:20</p> <p><b>publicly</b> 171:4</p> <p><b>published</b> 94:15 117:3,7 213:25</p> <p><b>pull</b> 97:17,20</p> <p><b>pulled</b> 198:20</p> <p><b>purchase</b> 33:4 43:25 96:13,15 154:12</p> <p><b>purchased</b> 55:21 64:6</p> <p><b>purchasing</b> 55:13 96:5</p> <p><b>Purdue</b> 58:25 59:8</p> <p><b>pure</b> 120:22</p> <p><b>purpose</b> 11:1 36:7 97:17 136:12 195:16,22 196:11 198:1 203:25,25 204:5,11 205:11</p> <p><b>purposefully</b> 129:2</p> <p><b>purposely</b> 191:22,25</p> <p><b>purposes</b> 35:6 36:9 179:8 195:22 196:14 199:8 200:19 200:21 205:23 217:5 218:13 240:7</p> <p><b>put</b> 18:20 21:18 29:19 34:12 36:25 45:19,22 59:15 66:3,8 68:6 88:20 98:17 113:25</p>
--	---	--

<p>117:13 129:13 143:16  147:12 170:4 178:14 182:22  184:23 194:20 195:21  213:14 216:6,25 247:13  <b>putting</b> 46:22 47:1 68:7  110:16 114:11 149:13  <b>puzzled</b> 28:16  <b>P-based</b> 63:15,23 64:24 96:3  96:3  <b>P-enriched</b> 93:14 104:11  105:6  <b>P-management</b> 142:17 148:8  <b>p.m</b> 106:19,20,21,23 123:4,8  152:10,11,12,14 195:1,2,3,5  233:24,25 234:1,3 251:3,5  <b>P205</b> 90:6</p> <hr/> <p style="text-align: center;"><b>Q</b></p> <hr/> <p><b>qualified</b> 16:10  <b>qualitative</b> 248:2  <b>quality</b> 6:13,15,23 7:1,8,15  27:25 28:3 88:21 134:2,5  159:15 171:11 197:6,15  237:1  <b>quantification</b> 227:7  <b>quantifies</b> 185:15  <b>quantitative</b> 73:18 229:10  230:3  <b>quantitatively</b> 73:5,9,11  119:11 194:13 226:25  <b>quantities</b> 16:5 54:25  <b>quantity</b> 14:24 15:6,10,23  20:8 73:21 88:3,4 215:9  229:24,25  <b>question</b> 8:14 21:1,3,4,18  24:17 31:13 33:17 35:6  36:8,8,9 41:16,17,18 42:7  42:17 47:25 59:17 67:19,21  68:20,24 74:3 82:12,20 83:3  83:10,12 98:3 99:25 107:14  131:7 137:7 141:4 143:25  146:15 157:2 158:10 159:14  160:4,4 161:8 165:9 192:8  193:19 194:1 197:13  <b>questions</b> 9:12,24 24:25</p>	<p>161:22  <b>quick</b> 44:20 67:17 123:1  <b>quickly</b> 87:25 91:2 106:11  114:2,4 115:3 118:14  <b>quite</b> 108:7 136:18 178:10  239:11  <b>quo</b> 43:17  <b>quote</b> 64:15 95:6</p> <hr/> <p style="text-align: center;"><b>R</b></p> <hr/> <p><b>R</b> 2:1 253:1  <b>radical</b> 128:22 129:22 130:3  130:7  <b>radically</b> 129:4,24  <b>rain</b> 76:25 77:14 81:2,4  112:20 138:5 230:24 231:7  231:10 233:9  <b>rained</b> 138:1  <b>rainfall</b> 74:5 77:9,15 80:13,14  83:7 132:21 168:21 178:23  178:24 179:5 231:4  <b>rainfalls</b> 77:18  <b>rains</b> 75:5 76:1,9 80:23,25  127:10 141:12 215:25  <b>rainstorm</b> 231:23  <b>raise</b> 31:15 90:5  <b>raised</b> 32:2 79:16 153:22  <b>ramifications</b> 34:2 53:16,17  <b>ran</b> 125:13  <b>ranchers</b> 63:16  <b>ranching</b> 182:15  <b>range</b> 20:1 156:16 170:8  179:2 203:18 205:9  <b>ranged</b> 103:19  <b>ranges</b> 168:2  <b>rapid</b> 153:4 168:3  <b>rapidly</b> 94:17 113:15  <b>rarely</b> 161:7  <b>rate</b> 30:25 33:7 38:14,18  55:14 63:21,23,24 64:1,16  64:17,18,24 65:1,1,4 67:1  89:15 90:19,24 91:4,5,8  92:12 100:14,15,15 108:10  110:9,9 118:4,5,17 119:5,12  119:16,16,20,22 120:3,8</p>	<p>121:6,8,10,15,17 122:4  168:12,18 188:17 221:23  239:13,17,22 242:7,10,25  243:1  <b>rates</b> 63:3,15 93:24 94:10  108:13,18 109:2 243:2  <b>rating</b> 39:2 40:3 223:22  237:10 244:3,8,10,19,24  246:1 249:9,11  <b>ratings</b> 245:5  <b>ratio</b> 19:15 62:19 109:11,12  155:7  <b>rationale</b> 236:14  <b>reach</b> 64:3,4 85:25 86:5  124:13 196:7  <b>reached</b> 138:7  <b>reaches</b> 74:10 85:23 125:3  126:6  <b>reaching</b> 112:13  <b>reactive</b> 114:18 115:8,12  199:15  <b>read</b> 14:19 15:1 17:6,8 18:12  67:20 79:18 88:25 93:10,18  94:23 95:17 97:11 103:5  105:7 107:5,7,11 108:21  109:9,23 111:7 113:3  115:21 116:7 133:23 134:5  143:10 144:1 147:8,19  148:1 149:21 157:16,24  158:13,14 161:18 171:4  174:24 180:25 185:12,13,13  185:17 200:24 205:2,2  206:19 208:4  <b>readership</b> 171:10,12  <b>readily</b> 55:4 249:16  <b>reading</b> 103:25 142:19  147:17 173:19 181:1 189:19  203:5 204:6 225:4,14  <b>ready</b> 13:1,25 152:6  <b>real</b> 29:15 37:24 40:6 50:15  86:6 115:3 122:9 182:19  183:7 198:15 204:8 210:24  213:10,10 226:16 235:22  <b>realignment</b> 191:18  <b>realistic</b> 185:17</p>
--	--	---

<b>realize</b> 37:14 130:24	234:1,2 251:2	<b>regions</b> 93:21 138:10,11
<b>realized</b> 107:13	<b>recreate</b> 190:14	191:22,23,23,25 192:1
<b>really</b> 9:23 31:12 37:10 39:19	<b>recycled</b> 69:12,18 102:12,14	223:7
52:14 65:15 74:20 91:1	191:4	<b>regression</b> 198:13,21,23,24
98:9 126:9 127:13,16 135:1	<b>recycling</b> 98:13 99:2	210:3,10
136:25 150:3 167:21 187:12	<b>red</b> 187:8,17	<b>regulates</b> 118:19,22
188:12,21,22 191:20 192:2	<b>redeposited</b> 97:22	<b>regulation</b> 96:16
193:19,25 229:1 245:12	<b>redistributed</b> 99:9	<b>regulations</b> 47:8 63:13 64:7
<b>realtime</b> 209:4	<b>reduce</b> 91:15 95:15 97:15	64:11 96:11
<b>reason</b> 43:21 54:19 65:4	105:25 106:5 110:19 113:13	<b>regulators</b> 134:13
134:19	149:7 150:16 157:21 164:10	<b>regulatory</b> 26:18 50:9 185:5
<b>reasonable</b> 25:20 73:23 90:10	164:18 205:18 220:4,16	<b>reiteration</b> 205:17
90:12 112:15 139:14	<b>reduced</b> 64:1,25 65:1,4 110:3	<b>relate</b> 195:25 236:22
<b>reasons</b> 186:5,7	253:13	<b>related</b> 195:18
<b>recall</b> 52:11 58:14,15 80:8,8,9	<b>reducing</b> 96:18,20 149:2,4	<b>relates</b> 200:10
88:23 89:2 107:23 136:12	193:3	<b>relating</b> 203:16 205:7
177:6 198:22 200:21 203:5	<b>reduction</b> 107:1	<b>relation</b> 7:10
204:6 222:14	<b>reductions</b> 102:25 105:19	<b>relationship</b> 6:14 9:2 188:20
<b>receive</b> 60:14 184:16	<b>Reed</b> 120:1	197:5 198:14,21 201:6
<b>received</b> 212:23	<b>refer</b> 223:25	211:5,8,9 215:4,8,14,21
<b>receiving</b> 46:8,16,17,18,23,24	<b>reference</b> 23:3 31:13 98:9	216:13,18 240:14
47:1,4 78:6,16 183:23 184:3	116:5 167:17,20 231:18	<b>relative</b> 14:24 35:20,21 70:21
184:4,12,14,20 196:7	<b>referenced</b> 57:12 95:2 111:4	161:3 170:1,5,21 178:14
<b>recess</b> 44:24 84:22 106:20	111:5 117:3 119:25 133:15	220:10 234:20 253:20
152:11 195:2 233:25	156:25 177:17 208:23	<b>relatively</b> 54:25 218:25 219:1
<b>recessed</b> 251:4	210:17 212:25	219:1 227:15
<b>recognition</b> 148:6	<b>references</b> 111:13 117:2	<b>release</b> 202:25
<b>recognize</b> 133:14 152:16	119:22 134:15 153:8,22	<b>released</b> 197:7
214:16 240:12	168:22	<b>releases</b> 118:14
<b>recollection</b> 48:17 57:13	<b>referencing</b> 115:5,10,18	<b>reliable</b> 91:9 120:10
108:5 135:16 230:22	<b>referred</b> 92:18 107:11,18	<b>reliance</b> 177:1,10,24
<b>recommend</b> 26:5	<b>referring</b> 146:25 160:13	<b>relied</b> 92:7
<b>recommendation</b> 22:15	187:14 192:15 211:2 226:7	<b>relocate</b> 98:19
37:12 45:24 46:13 143:4	<b>refers</b> 116:5 215:13,13	<b>rely</b> 167:20,22 169:16
145:9 237:18 250:8	<b>refined</b> 151:24	<b>remain</b> 43:17 110:3 205:15
<b>recommendations</b> 21:15	<b>reflect</b> 173:16	<b>remainder</b> 167:15
22:11 64:13 156:9,14 183:1	<b>reflected</b> 105:4,14	<b>remains</b> 185:7
<b>recommended</b> 52:9	<b>regard</b> 21:16 136:6 164:14	<b>remedial</b> 185:4 186:13 187:8
<b>recommending</b> 22:12 147:3	194:21 243:23	<b>remediate</b> 97:15 104:10
<b>Record</b> 4:3,6 41:16 44:22,25	<b>regarding</b> 18:9 28:17 44:6	112:25 113:6
45:2 62:11 84:20,23,25	47:9 188:19	<b>remediating</b> 114:2 118:21
106:18,21,22 123:3,6,7	<b>regardless</b> 83:18	<b>remediation</b> 97:7 110:2,9,11
147:18,25 148:2 152:9,12	<b>regards</b> 23:17 88:10	110:24
152:13 185:14 194:20,25	<b>regimes</b> 184:21	<b>remedy</b> 110:12,13,15,17
195:3,4 218:13 233:23	<b>regionally</b> 153:20	<b>remember</b> 8:25 9:9 10:22

<p>13:15 20:2 45:9 48:14 52:13 58:8 63:4 87:3 157:10 177:7 178:17 197:14 220:6 <b>remote</b> 110:1 <b>removal</b> 107:18 110:25 114:7 118:4 168:1 <b>remove</b> 96:22 97:24 102:2 105:6 110:7,8 <b>removed</b> 99:5 101:18,19 102:18 103:10 105:13 158:17 182:3 <b>render</b> 54:8 <b>repeat</b> 21:4 67:19 <b>replace</b> 45:7 <b>report</b> 13:3 14:22,23 56:20 85:8 88:12 89:4,8 90:7 92:19,25 93:8 94:2 96:25 107:12 117:10 119:11,15 134:25 152:17,24 159:13 164:20,24 165:2,6,22 167:6 176:24 177:4,9,13,14,18 178:8,12,22 193:18 194:11 195:7 196:16 198:20,20 199:4 205:24 206:6,12,13 207:22,25 208:4 211:2 212:24 213:5,16,19 218:3,7 250:6 <b>reported</b> 58:10 253:11 <b>reporter</b> 1:20 67:18,20 117:15 253:7 <b>Reporter's</b> 3:7 <b>reporting</b> 171:20 <b>reports</b> 32:1 88:20,22 163:13 177:24 178:3 <b>represent</b> 9:10 174:12 <b>representation</b> 166:8 <b>representatives</b> 11:17,23 <b>represented</b> 77:6 198:23 <b>representing</b> 169:13 <b>represents</b> 219:14 <b>require</b> 184:22 <b>required</b> 14:25 54:24 62:13 95:14 109:17 <b>requirements</b> 94:11 96:7</p>	<p>154:11 155:2 184:16 187:9 <b>requires</b> 155:11 <b>reread</b> 111:14 <b>research</b> 31:25 136:18 163:18 185:11,14 186:10 213:25 216:17 221:14,16 <b>researchers</b> 53:4 <b>resistant</b> 118:15 <b>resolved</b> 218:25 <b>resource</b> 192:10 <b>resources</b> 1:7 186:12,21 <b>respect</b> 36:10 38:4 <b>respective</b> 247:19 <b>respond</b> 161:24 <b>response</b> 142:24 156:5 228:16,18 <b>responsibility</b> 51:13 54:4 180:13 <b>responsible</b> 50:1 52:9 <b>responsive</b> 156:16 <b>rest</b> 239:25 <b>restrict</b> 147:4,13 <b>restriction</b> 39:5 <b>restrictions</b> 24:22 25:12 33:11,23 34:10,22 35:11 42:20 60:15 61:3,16 <b>result</b> 16:6 40:3 93:23 143:14 144:10,10,12 145:17,18 163:17 174:8 176:14 <b>resulted</b> 22:14 <b>resulting</b> 146:4 <b>results</b> 86:18 91:25 92:1 101:16 104:16 114:16 115:4 155:10 163:5,8,22 171:20 <b>resume</b> 114:22 <b>resuming</b> 116:14 <b>retained</b> 102:14 124:14 <b>return</b> 188:18 224:10,14 230:10,17 231:2 233:13 234:4,4,19 235:4 244:10,13 245:5,13,15,20 249:13 <b>returned</b> 190:7 <b>returns</b> 69:18 114:8 <b>reversible</b> 168:4 <b>reversing</b> 190:15</p>	<p><b>review</b> 57:10 <b>reviewed</b> 5:23 10:23 13:5 60:20 88:19,22 160:15 <b>rewind</b> 154:21 <b>rhetorical</b> 192:7 <b>rhyme</b> 218:17 <b>rich</b> 191:16 <b>right</b> 5:21 7:3 18:12 20:16 25:3,10 38:6 41:1 42:4,10 45:14,16,23 46:5 54:21 55:7 56:21,23 57:19 61:9 63:10 68:4,11 69:19 70:8 71:8 74:23 75:19 76:5,11,12,15 76:18 77:19 81:12 87:10,14 93:3,4 94:12,19,21 95:3,4 101:11 107:2 111:4,20 113:1 115:19 116:4 117:5 128:11 130:15 131:1 132:6 134:16 135:15,24 138:3,22 139:6 141:7,10 143:6 144:14 145:2,15 146:22 147:1 152:24,25 154:25 158:24 160:23,24 167:12 168:6 172:12,15,19,20 173:2,8,13 174:4,16,22 175:10,18,23,24 176:2,23 179:9,25 189:5,19 190:22 192:23 197:12 198:4,9,11 200:2,4,6,7 202:14 204:22 204:25 206:8,11 207:4,11 207:12,13,17 209:4,13,15 210:1,2,4,18,23 211:7,25 212:8 214:5 216:21,24 218:7 220:20 221:13 222:15 224:18 225:7 226:2,10 227:5,18 228:8 229:18 230:18,19 231:14 232:8,16 232:18,20 235:1 237:11,13 237:22 238:24 239:8,11 240:12,25 241:2 242:8,20 244:6,11 246:2,10,12,15 247:4,13,20 250:20 <b>right-hand</b> 101:9 109:9,23 137:10 153:3 167:6 173:12 173:12 198:25 202:16</p>
--	---	--

**risk** 34:18 35:20,21,23 36:16  
 37:9 38:15,19,23,25 39:15  
 40:15 43:13 44:3 96:10  
 117:1 149:2,4 150:8,16  
 151:10 154:12 155:17 218:4  
 219:1 220:1,10,13,16  
 221:21 232:3 233:7 234:20  
 236:18,20 240:25 241:6,21  
 241:24,24 242:8 243:21  
**riskier** 234:23 242:15  
**riskiest** 242:2  
**risky** 241:2 245:7  
**river** 16:9,12,14 21:24 22:2  
 30:1,7 47:11,14 55:23 60:2  
 60:6,13 61:2,15 67:5,11  
 70:9,10 72:7,11,13,20 73:1  
 73:6 74:1,23 75:17 77:2,10  
 77:21,21,25 78:25 79:10  
 80:11,17,22,24 81:9,18 85:5  
 88:9,21 90:11 92:4 94:5  
 99:4 102:7,17 120:13 124:1  
 124:19 126:14 127:24 130:2  
 134:4,20 136:17,21,24  
 137:5 140:16 142:8 154:2  
 159:7,10,15,19 160:6  
 161:16 162:3,8,16,20 163:7  
 184:15 232:22 250:3,10,19  
**road** 182:5,14  
**Robert** 2:3,22  
**robustly** 113:17,19  
**rock** 66:23 190:14,24  
**rockiness** 24:5  
**Roger** 57:10  
**role** 11:8 26:12 53:14 134:9  
 194:3,7,8,12  
**room** 139:25  
**root** 65:8,12 66:1,6,7 110:13  
**rooting** 65:23 98:15  
**roots** 66:5,9 98:16,20  
**roster** 12:2  
**rough** 204:2  
**roughly** 19:25 100:22 119:18  
**row** 105:2 241:4,5,16 247:3,5  
 247:16  
**rows** 247:1

**rule** 20:12,13 31:9 101:4  
 141:11 194:21 240:9  
**rules** 47:8  
**run** 50:16 76:13 124:24  
 125:12 141:3 212:24 220:8  
 227:10 245:17  
**running** 198:2 200:19  
**runoff** 69:13,25 75:6,8,9,11  
 76:1,17,20,22 77:17,18,20  
 78:2,6,9,10,16 82:22 83:24  
 84:8 85:17,19,23,25 86:5  
 93:13 95:1 112:9,12 114:18  
 114:20 116:25 117:9 124:21  
 125:1,2,15,16,19 127:14,15  
 129:25 132:5,8,20 136:10  
 137:11,16,17,21,22 138:8,9  
 138:14,17,20,21,25 141:3,6  
 141:13,13 143:15 144:11,17  
 145:18 146:4,7,8,9,16,16,16  
 146:19 148:12 149:2,3,6,8,8  
 149:13 150:19 166:4,9,22  
 166:25 168:11 169:2 195:19  
 195:25 196:5,5,6 197:8  
 199:15 201:7,7,8,17 202:4,8  
 202:25 203:13,17 205:5,8  
 205:14 207:10 208:7 210:22  
 211:5 214:25 215:1,5,18,21  
 216:19 217:13 224:10,16  
 226:18,23,23 227:7,10,12  
 227:16,21,22,22,22 228:4  
 229:14,20,22 230:24,25  
 231:5,24 233:3,10 241:11  
 244:8,14 245:1,20  
**runs** 77:13  
**rushed** 116:3  
**Ruston** 172:9

---

**S**


---

**S** 2:1 3:3,3  
**sacrifice** 205:21  
**sacrificing** 205:15  
**sample** 178:25 202:3 216:15  
**sampled** 206:17  
**samples** 57:16 114:18  
**sampling** 86:19,20,21

**sand** 132:16  
**Sanders** 2:22 4:20,20  
**sandy** 169:4 172:9  
**sat** 14:2  
**satisfied** 6:1 115:24 196:12  
 197:12  
**satisfy** 32:23 33:18 158:13  
 206:19  
**saturated** 137:25  
**saturation** 197:6  
**saw** 121:9 122:9 222:11  
**saying** 15:13,24 28:23 34:7  
 44:11 57:8 84:6 97:13  
 113:20 121:11 135:19  
 143:15,20 146:2 148:20  
 150:11 151:23 158:3 171:8  
 171:13 179:11 189:21  
 197:15 202:2 203:24 204:3  
 204:6 205:11,20 215:4  
 227:10 231:22 237:5,9  
**says** 17:5 41:12 56:19 64:17  
 65:8 90:13 93:17 94:16  
 96:17 101:17,24 104:5  
 105:18,20 110:23 111:21  
 112:7 114:15,16 115:15  
 116:9,23 119:4 137:10,14  
 137:21 138:22 142:16,21  
 143:9 144:12,14,16 145:16  
 147:2 148:16 150:12 169:21  
 172:2,14 173:14 185:14  
 197:1 198:10 201:20 206:15  
 213:23 217:11 224:22  
 231:16 232:17 243:25  
 244:12  
**scale** 137:16 157:21,24 158:4  
 158:8 170:1 180:25 181:1,2  
 181:20 193:6 227:15 229:6  
 236:20 247:9 249:1,1  
**scales** 170:22 188:5 191:10  
 193:4 238:3  
**scenario** 25:19 26:2 30:16  
 37:10 40:25 41:9,11 43:21  
 44:1,11,17 46:6 50:5 64:24  
 64:25 102:10 128:20 141:17  
 150:22 178:13 179:3 184:4

<p>220:7,7,8  <b>scenarios</b> 62:1 63:15 108:12  125:16 203:19 205:10  213:10 228:15  <b>scheduled</b> 47:19  <b>scheme</b> 42:12 247:8  <b>scholars</b> 48:9  <b>science</b> 5:13 81:25 150:12  214:7 227:18 229:12 243:9  243:11  <b>scientific</b> 73:23 161:23 214:3  214:13 221:9,13 226:11  227:5,20  <b>scientifically</b> 72:17 84:9,16  90:10 144:21 145:19 235:3  235:12  <b>scientist</b> 5:12 49:21 53:12  72:24  <b>scientists</b> 26:25 53:4,19 54:15  134:12  <b>scope</b> 88:12 98:9 134:24  159:12,22 193:17 194:10  198:6 250:6  <b>score</b> 236:24 247:10  <b>scoring</b> 236:23  <b>Scott</b> 2:15 4:12 57:23  <b>scrutiny</b> 184:5,7  <b>SEAL</b> 253:22  <b>second</b> 16:3 65:8 67:16 77:15  92:24 95:10 100:7 103:16  111:21 114:6 123:11 127:11  127:12 133:7 135:17 142:16  165:24 172:21 177:16 180:5  192:25 193:1 194:16 218:6  <b>secondary</b> 93:5  <b>seconds</b> 140:4  <b>SECRETARY</b> 1:6  <b>section</b> 14:21 27:3 164:20,21  165:11 180:3 193:11 200:24  203:8 205:24 213:15 230:16  <b>sections</b> 194:21 228:21,21  <b>see</b> 7:22 9:1 15:12 32:7 40:8  63:18 69:7,10,14 85:10 87:6  101:8 105:13 107:10 122:7  122:12 131:17 135:17</p>	<p>142:19 143:24 144:1 146:11  152:1 153:1 165:5,17 167:5  167:8 171:18 172:1,4 177:8  195:17 198:18 202:20  203:10 204:6 224:4 230:7  230:14,16 232:19 235:10  236:5 239:25 242:10 243:25  244:2 247:15  <b>seemingly</b> 160:12  <b>seen</b> 22:2 37:2,6 75:22 80:17  81:8,15 87:1 99:24 140:19  160:15,19,25 166:20 221:13  221:16 222:5,7,9 223:1,2,13  <b>seep</b> 126:7  <b>segmented</b> 227:24  <b>segments</b> 27:1 226:13  <b>self-defeating</b> 113:25 114:1  <b>sense</b> 12:7 29:18 32:14 49:22  111:21 190:16 210:11  <b>sensitive</b> 36:21  <b>sent</b> 89:3  <b>sentence</b> 14:18,20 15:4 16:3  17:6 18:8,14 65:8 69:6  89:25 93:10,18 94:15,23  96:2,8,17 97:1,10 101:17  103:16 104:6 105:2,18  109:10,24 111:8 112:7,12  115:3 116:23 117:2,3 118:7  119:4 123:11 133:24 134:16  137:14 138:22 142:16,21  143:10,24 144:1,21,24  145:6 147:2,7,8 149:18  153:11,19 154:8 155:7,16  156:24 157:5 158:3 169:3,9  170:17 180:15 185:14  186:10,14 192:25 193:1  197:11 202:19 203:6,9  205:2,13  <b>sentences</b> 105:23 158:11  181:11 185:10 186:14  <b>separate</b> 17:19 18:1 122:10  224:15 233:11  <b>separated</b> 17:7,8  <b>sequence</b> 30:14  <b>SERA-17</b> 212:21</p>	<p><b>series</b> 221:24  <b>seriously</b> 162:21  <b>served</b> 43:14 97:20  <b>sessions</b> 12:22  <b>set</b> 45:16 124:24 142:17  172:12  <b>sets</b> 239:12  <b>seven</b> 116:6 155:9  <b>seventeen</b> 204:22  <b>severely</b> 39:15  <b>shallow</b> 66:10,12,16 98:15  126:6,11  <b>shallowness</b> 24:4  <b>Sharpley</b> 48:19,25 49:6 94:19  117:4 152:23 165:17 166:7  167:23 169:20,24 170:16  171:13 177:14 178:5,9,16  179:6 203:22  <b>Sharpley's</b> 177:1,17 179:22  <b>Sheri</b> 167:23  <b>She'll</b> 117:15  <b>shift</b> 129:23  <b>ship</b> 29:11  <b>shipping</b> 55:19  <b>shore</b> 71:10  <b>short</b> 15:17 44:24 84:22 86:9  152:11 195:2 233:25  <b>Shorthand</b> 1:20 253:7  <b>show</b> 46:20 57:20 77:8 100:2  107:9 116:24 118:23 119:22  139:14 165:13,16 206:9  214:15 219:25  <b>showed</b> 115:6 213:15,17  <b>shown</b> 167:11 203:15 205:6  211:8 216:22  <b>shows</b> 76:24 80:1 90:23  166:22 174:2,3 211:4  216:17  <b>side</b> 33:2 98:2 139:24 140:2  172:11 173:13 202:16  247:13  <b>Sidley</b> 8:15,17,19  <b>Sigma</b> 245:23  <b>sign</b> 252:7  <b>Signature</b> 3:7 252:1</p>
---	--	---



<b>significance</b> 57:7 59:12 <b>significant</b> 102:25 114:16 115:4,16 <b>silage</b> 150:15 <b>silt</b> 132:16 137:1 <b>silty</b> 137:1 <b>similar</b> 163:1 177:15 220:25 229:19 237:23 <b>similarity</b> 148:6 <b>similarly</b> 90:14 221:21 <b>Simmons</b> 2:12 4:16 <b>simple</b> 67:22 68:3,3 205:15 205:19,22 209:20 235:12,25 238:9,21 <b>simpler</b> 203:23 <b>simplest</b> 195:11 <b>simplistic</b> 91:9 213:11 227:25 <b>simply</b> 15:5,6 24:2 39:17 114:11 186:12 187:16 <b>simulation</b> 178:23 179:5 <b>single</b> 18:11,23 28:19 33:21 39:22 44:8 121:19 185:11 186:11 195:18,24 197:1 198:8 199:24 203:16 205:7 209:16 211:8 234:21 243:7 <b>sink</b> 142:5 185:20,21 <b>sinks</b> 125:23 126:18 185:15 <b>sir</b> 5:8 8:9 12:14 16:15 18:15 21:25 25:6 57:2 59:19 63:20 75:3 77:4 80:25 81:3 81:5,7,10 82:2,4,7 85:8 87:7 96:8 97:10 99:19 100:23 102:23 103:13 104:25 112:23 114:15 117:17 118:7 123:10,25 131:5 135:22,25 153:19 158:1 165:3 169:23 170:19 172:24 175:2 191:2 203:7 218:10 <b>site</b> 12:16 29:6 30:5 34:4,8,9 34:16,24 35:3,7 36:3,21 37:6,9,13 38:8,14,18 39:2,9 43:11 46:24 75:6,11 76:9,20 76:22 78:4,15 85:17,20 100:15,18 102:3,9,11,14,18	103:20 110:1,7,8 120:3 123:13 126:7,9,10 127:20 127:25 132:22 136:15,19 137:16,22 146:7,10,13,14 146:25 151:4 162:12,14,22 163:1 181:24,24 184:12 189:8,9 201:7,9 202:8 204:18 216:7 224:3 225:4 227:12 229:4 233:5,15 236:7,23 237:10 247:8 248:1 <b>sites</b> 30:17 32:7 34:17,18,22 35:10,12 39:14 74:8 75:23 78:25 79:23 80:1,5 94:7,8 97:3 103:8 109:5 145:12,14 146:3,5 156:15 162:11,15 162:21,24 163:2,3,6 170:10 170:11 183:23 198:16 219:24 220:2 <b>site-by-site</b> 30:22 170:15 196:4 <b>site-specific</b> 34:19 36:5 162:19 166:9 196:4 218:3 <b>sitting</b> 241:19 <b>situation</b> 25:15 29:4 40:22 43:24 46:11 52:17,18 64:19 87:21 88:25 109:18 110:16 122:24 125:13 154:9 179:3 220:1 225:1 228:23 230:5 <b>situations</b> 16:4 31:19 40:21 46:14 52:3 94:16 108:17 124:18 229:2 241:16 <b>six</b> 17:4 62:23 155:8 175:25 213:23 231:10 <b>size</b> 136:16 233:9 <b>skip</b> 107:3 181:11 <b>sleeping</b> 140:6 <b>slope</b> 23:19 24:4 128:13 129:1,6,8,10 132:15 222:1 <b>slow</b> 110:25 <b>slowly</b> 66:25 110:3 168:4 223:18 <b>small</b> 70:13 74:11 96:25 131:17 135:15 136:18,18 149:25 169:11 178:23	194:14 <b>smaller</b> 15:10 38:7 242:9,16 242:19 <b>software</b> 222:8,9 <b>soil</b> 5:12 6:11,18 10:16 15:19 16:7 20:17,18,19 23:20 24:4 30:17 31:1,16 37:8 38:5,19 39:19 44:16,18 49:21 53:12 53:19 54:15 63:8 65:10,16 66:8,9,21 67:1,2,5,13,23 68:1,7,16,22 69:1 74:5,6 76:6,8,21 77:17 83:17,19,19 83:20,23,23 84:2 85:16 86:14 87:12 88:1,2,4,5 89:9 89:13,13,16 90:5,24 91:7,16 94:16,25 96:18,22 97:17,23 98:8,15,19,20,20,23 99:20 100:24 101:20 102:25 103:2 103:11,17 105:4,11,14,14 105:19 107:1 108:9,10,23 109:12,16 110:2,10,19,24 111:10,11,12,17,20,22,23 112:5,8,19 113:14,20 114:3 114:8,18,20 115:8 116:18 116:24 117:8 118:2,2,9,11 118:12,17,19,20,23,24 119:1,6,14,17 120:4,7,12 121:5 124:25 125:1,6,14 126:1,1,2,5,9,11,22,23,25 127:17,19,20 128:21,23 129:3,4,6,9,17,20,21,23,24 130:1,8,12,13 132:14,15,18 136:9,9,12 137:11,24 143:7 146:3 155:11,11 160:19,22 160:24 162:12 168:5 171:3 176:15 185:23 195:18,19,25 197:7,8 199:13 201:6 202:3 203:13,17,18 205:4,8,9,14 208:10 209:14 211:20 214:1 214:2 215:14,21 216:13 217:12 219:18 224:10,16,17 224:18 226:5 228:25 237:1 237:4,25 241:10,10 246:9 247:6 <b>soils</b> 15:1 16:8,12 20:18 32:9
---	--	--

37:3,7 66:22 85:9,13,15 90:10 91:18 93:14,22 94:4 95:15,20 96:3,20 104:11 111:19 113:6 120:13 136:20 136:21,23 137:1 142:18,22 144:25 148:8 169:5 202:23 202:24 <b>solely</b> 142:17 <b>solid</b> 118:11 126:24 235:16 <b>solubility</b> 215:9 221:23 <b>soluble</b> 65:9 75:7 76:4,7 94:25 114:17 115:7,12 118:15 127:17,20 128:24 129:7 131:5 176:9 195:19 201:8 214:2 215:9 <b>solution</b> 127:21 185:11 186:11 <b>solutions</b> 181:12 <b>solve</b> 159:5 <b>somebody</b> 46:4 47:24 <b>somewhat</b> 187:12 <b>sooner</b> 133:13 <b>sophistication</b> 217:10 <b>sorption</b> 111:11,22 112:4,5 168:4 197:5 <b>sorry</b> 57:2 82:12 97:4 100:4 125:10 168:17 170:25 239:4 239:10 <b>sort</b> 9:25 91:16 127:8 129:12 136:7 186:3 191:15 248:1 <b>sound</b> 60:22 153:14 180:7 <b>source</b> 43:25 54:20 55:9,16 64:5 67:24 83:25 95:17 110:1 113:22,23 123:14,19 134:2,21 144:15,18,19 145:8 156:3 157:7 185:20 185:24 219:12,13,17,22,25 221:22 231:19 236:7 239:16 239:17 242:7 245:25 246:4 <b>sources</b> 32:19 51:1 82:10 183:11 185:15 246:8 <b>south</b> 2:16 17:3 <b>space</b> 202:2,4,6 <b>spatially</b> 157:7 <b>speak</b> 16:10 124:6 182:24	192:5 <b>speaking</b> 54:14 62:22 64:9 214:3 <b>specialist</b> 53:13 <b>specialists</b> 7:8 54:16 <b>species</b> 65:16 113:17 <b>specific</b> 15:1 30:5 34:4,16 71:25 72:6 73:21 78:4 107:14,15 120:4,4,4 146:25 170:8 181:16 203:13 205:4 210:14,15,25 211:19,19,20 <b>specifically</b> 16:11 49:3 65:21 67:6 170:15 187:14 250:11 <b>specify</b> 24:19,23 <b>speculate</b> 122:23 156:7 218:1 <b>speculation</b> 156:8 <b>speed</b> 58:11 88:24 <b>Spell</b> 107:20 <b>spelled</b> 48:16 <b>spend</b> 186:23 249:24 <b>spent</b> 249:22 <b>spikes</b> 76:25 <b>split</b> 197:5 <b>spot</b> 40:8 130:22 <b>spread</b> 241:15 <b>spreading</b> 55:11 <b>spreadsheet</b> 80:5 ss 253:3 <b>staff</b> 221:12 <b>stage</b> 191:13 <b>stand</b> 152:7 <b>standard</b> 31:15 179:15,16 220:22 <b>started</b> 91:4 173:17 206:19 208:22,22 <b>starting</b> 93:20 208:20 <b>starts</b> 74:5 85:9 115:3 148:2 <b>state</b> 1:5,8,19,22 4:7,9,11 5:5 11:13 26:18 29:9 50:8 52:19,21 53:1,5 86:12 88:20 143:3 156:9 161:10,15 193:21 237:18 239:10 253:3 253:8 <b>stated</b> 90:2 214:4 <b>statement</b> 14:21 24:6 34:6	35:4 44:5 56:22 65:14 92:11 93:15 94:21 95:9 97:13 109:20 111:3 114:24 115:9 145:25 153:8,23 154:14,16,20,23 155:14,19 162:16 167:19 168:8,10,24 185:8 187:11 <b>statements</b> 153:2 167:5 <b>states</b> 1:1 29:10 153:15 167:11 191:24 192:1 204:22 220:24 223:6 <b>State's</b> 193:22 <b>statistical</b> 49:20 104:23 <b>statistically</b> 104:17 <b>status</b> 43:17 <b>stays</b> 91:3 99:13 102:11 <b>steam</b> 240:13 <b>steep</b> 120:1,2 <b>Steinmeyer</b> 1:20 252:5 253:6 253:24 <b>stemmed</b> 165:24 <b>stenograph</b> 253:12,12 <b>step</b> 25:17 28:8,13 149:3,7,10 149:11,16,25 150:1,11,16 150:21,23 190:17 <b>stepping</b> 72:9 <b>step-by-step</b> 150:9 <b>stickers</b> 13:11 <b>stop</b> 67:15 89:14 90:25 114:11 128:17 129:13 130:16,21 142:24 175:23 251:1 <b>stopped</b> 31:20 148:21 174:6 175:25 176:11 <b>stops</b> 77:19,23 <b>storm</b> 137:17 230:23 231:25 232:3,4,6,21 233:2,12 <b>storms</b> 139:1 232:23,24 <b>STP</b> 30:19 31:4,10,23 32:2 34:13,14,24,25 35:12,13 36:1,10 37:3,8 38:20 39:6,6 39:25 40:4,15 61:17,20,23 62:5 76:10 79:1 80:2 87:18 87:23 88:1 89:16 90:5,5,15 104:1 106:5,10 108:25
--	---	--

109:3 116:13 118:5 119:5,9 128:7 162:2 164:10,18 176:12,17 201:6 206:16 207:9 210:22 211:5 214:1 215:1,5 217:2 221:4 237:6 <b>STPs</b> 30:6,10 32:6 36:23 38:4 38:12 75:17 76:4 79:23 101:8 102:18 121:12 159:20 160:6,14 162:21 <b>straight</b> 37:11 67:25 117:16 <b>strategic</b> 191:17 <b>strategies</b> 193:5,13 <b>strategy</b> 26:22 27:8 <b>stratification</b> 111:25 <b>stream</b> 125:24 127:24 130:17 136:11 137:21,23,24 138:5 138:6,7,11,12,15,16,18,21 139:5 140:17 141:6,9,18,18 141:22,24 142:2 148:7,8,9 148:12,15,23 150:18 159:16 201:5 231:20 232:10,22 233:6,10,16 234:8 245:9 <b>streams</b> 77:21 <b>Street</b> 2:4,6,10,13 <b>strike</b> 74:21 148:25 <b>stringent</b> 184:1 <b>strongly</b> 243:22 <b>structure</b> 223:9 <b>structured</b> 222:6 <b>student</b> 11:16 <b>studied</b> 16:12 67:6,7 136:1,4 <b>studies</b> 12:6 32:1 90:3 91:17 91:25 92:1,3,4,7,14,18 114:16 116:24 132:24 156:15 163:9 178:23,24 179:6,7 <b>study</b> 6:7 91:20 101:24 102:2 104:13 105:3 115:6 135:14 136:8,19 140:15 141:5 142:7 143:4 163:16,18,18 171:21 203:21 <b>studying</b> 249:22 <b>stuff</b> 167:24 <b>styled</b> 1:17 252:6 <b>subfield</b> 219:16	<b>subject</b> 69:2,11,25 70:4 83:21 91:21 99:14 242:2 <b>submitted</b> 13:4 <b>subparagraph</b> 16:17,18 22:21 54:18 56:9 57:1 63:12 68:25 69:5 117:18 120:20 123:9 133:15 211:3 213:14 <b>SUBSCRIBED</b> 252:17 <b>subsequent</b> 77:18 <b>subsidize</b> 51:2 52:25 193:23 <b>subsidized</b> 29:8 <b>subsidizes</b> 29:10 50:18 <b>subsidy</b> 52:24 <b>substances</b> 57:8 <b>substantial</b> 66:22 123:14 159:19 169:6 220:12 <b>substantially</b> 109:17 <b>substitute</b> 208:9 <b>substituting</b> 113:7 <b>subsurface</b> 168:12 172:8 173:10 176:21 <b>subwatershed</b> 27:23,24 <b>successful</b> 97:6 <b>suck</b> 140:11 <b>sufficient</b> 16:4 <b>sufficiently</b> 142:22 <b>suggest</b> 52:4 114:19 116:17 148:8 <b>suggested</b> 50:6 52:3 <b>suggesting</b> 21:23,25 144:16 145:12 <b>suggests</b> 143:10 144:4 <b>Suite</b> 2:10,17 <b>sum</b> 246:22 <b>summaries</b> 201:13 <b>summary</b> 91:24 92:1 93:7 97:13 180:3 185:2 198:10 <b>summation</b> 245:24,25 <b>summer</b> 178:17,18 212:22 <b>supervision</b> 253:14 <b>supplement</b> 64:5 <b>supplied</b> 241:13 <b>supply</b> 20:14 21:15 33:6 43:7 43:10,15 96:6 118:19,21	180:14,14 <b>supplying</b> 21:17 65:2 150:14 <b>support</b> 137:16 228:10 <b>supported</b> 121:9 <b>supports</b> 139:19 221:14,16 <b>suppose</b> 42:18 165:1 <b>sure</b> 10:19 14:6,8 18:3 25:1,4 53:14,21 104:18 115:1 124:21 133:21 135:18 143:5 152:19 159:23 189:19 202:12 206:7 209:12 <b>surface</b> 65:10 66:4,6,8 69:2 69:13,25 77:16 80:14 93:13 98:20 111:12,17,20,22 112:1,8,19,21 123:20 124:13,22 125:14 132:15 134:1 136:10 137:24 138:25 141:22,24 142:4 149:3 155:18 166:3 168:11 172:8 173:10 174:24 175:1,4,6 176:7,15 227:16 240:20,22 241:10,15,22,25 <b>surface-saturated</b> 137:18 <b>surplus</b> 153:12 161:12 <b>surpluses</b> 153:19 <b>surprise</b> 77:5 <b>surprised</b> 153:18 223:15 <b>surrounding</b> 6:22 7:1 188:21 <b>suspect</b> 94:7 128:22 156:12 162:24 204:7 <b>sustainability</b> 188:1,10,12,14 188:18,19 189:3 192:12,20 193:2 <b>sustainable</b> 180:6 188:15,16 188:24 <b>switch</b> 238:3 <b>sworn</b> 4:23,25 252:17 253:9 <b>synonymous</b> 19:12 <b>system</b> 90:25 98:11 100:9,9 101:17,20 103:10,21,23 104:11 105:17,20 110:21 135:10 185:23 249:10,11 <b>systems</b> 9:16 31:14 65:8,12 95:12 96:3 103:5 104:3 105:5,10 135:6 155:5
---	---	--

T		
<b>T</b> 3:3 253:1,1	209:6,8 210:10 211:14	39:19 63:8 76:6,21 86:14,21
<b>table</b> 99:18,22 100:2,12	229:21 231:9	88:1,2 89:9,13 90:24 91:7
141:23 142:3 171:18,23	<b>talks</b> 112:25 114:15 145:7	105:19 108:10,10 110:10
223:1,3 246:25	172:2 199:25 207:6 216:14	113:6 114:8,20 115:8
<b>tabulation</b> 236:24	<b>tape</b> 45:4 123:2 187:8,18	116:18,24 117:8 118:23
<b>tailors</b> 140:16	233:21	119:14,17 121:6 146:3
<b>take</b> 44:20 49:2 51:12 54:4	<b>tapes</b> 44:21 84:19	160:19,22,25 163:17,22
67:17,25 68:1 78:13 86:9	<b>targeted</b> 191:25	195:18,25 199:13 203:1
98:14 102:3 104:10 105:24	<b>tasked</b> 175:17	208:10 209:14 211:20
106:8,9 115:20,21 116:6,7	<b>taught</b> 11:15	215:14,21 216:13 217:12
120:12 121:1 122:1,3,6	<b>taxpayers</b> 50:23 51:6	237:2,4,25 246:9,13 247:6
123:1 139:21 149:3,9,11,17	<b>teach</b> 5:10 11:2,4 81:25 82:3	<b>testified</b> 5:1,19
152:8 164:14 190:17 195:9	<b>teaching</b> 5:13 249:24	<b>testify</b> 4:25 10:20 13:2 14:1
199:6 210:2 215:11	<b>team</b> 26:23	47:14,19,21,22,24 48:5,7
<b>taken</b> 1:17 66:1 68:21 83:21	<b>teams</b> 26:23	49:7 59:13 85:3 86:11
102:9 105:16 174:12 185:22	<b>technical</b> 170:2,3	130:6 178:1,2 250:23 253:9
185:22 211:17 232:11	<b>technique</b> 84:4	<b>testimony</b> 5:23 6:1 12:25
253:18	<b>techniques</b> 39:21	14:8 18:6 59:16,20,24 72:10
<b>takes</b> 95:25 96:22 106:4,5	<b>telephone</b> 48:12,13	84:15 211:23
169:10	<b>tell</b> 8:19 36:20 54:18 56:9	<b>tests</b> 179:5 200:6 202:23
<b>talk</b> 8:21 17:6,11 20:4 23:1	67:4 73:10 82:12 83:25	<b>text</b> 169:20 212:1,2,3
23:25 49:24 57:3 65:18	84:6 87:25 89:10 91:13	<b>textural</b> 132:15
69:16 73:15 78:8 93:11	108:4,20 123:16 178:19	<b>Thank</b> 4:22 13:14
109:10,24 111:8 113:3	183:20 186:1 212:20 213:16	<b>theory</b> 192:3 250:11
131:14 132:4,15 133:7,24	219:11 238:18 248:7 249:3	<b>Theresa</b> 2:9 4:17
165:15 173:1 178:7,16	<b>telling</b> 22:17 28:20 36:7 40:2	<b>thing</b> 12:18 13:21 27:19,21
180:5 183:4 188:7,9 209:19	45:5 78:19 81:15 203:22	69:21 87:13,20 105:21
212:17	206:18	121:20 127:8 141:20 176:20
<b>talked</b> 12:21 47:20 48:10,11	<b>tells</b> 209:10	185:12 229:3 236:8 240:10
48:19,23,25 49:3,10 60:1	<b>temperatures</b> 235:23	245:9 247:17 249:7
63:3 67:9 75:21 86:11 94:9	<b>ten</b> 84:6 90:6 109:13 119:18	<b>things</b> 8:23 16:19,22 24:6
111:3 113:11 120:2 128:10	140:3 231:3,8,13,24 234:7	34:14,21 49:5 53:20 72:23
131:4 141:8 155:23 179:6	234:24	89:22 131:4 137:9 151:6,23
180:19 182:7 188:8 189:7	<b>tend</b> 98:13	152:2 155:13 170:1,4
191:11 201:16 205:18 206:3	<b>tens</b> 160:23	178:14 197:23 201:18 222:2
231:18 236:17	<b>tenth</b> 82:19 231:3	235:21 236:9 243:17 247:24
<b>talking</b> 17:5,11 24:11,14 29:9	<b>ten-year</b> 230:17 231:7,10,16	<b>think</b> 7:8 8:18 9:1 16:10
33:16 34:9 47:24 56:16	231:24 232:3,24	22:20 30:4 31:6 32:9 34:6
57:1 67:3 103:13 106:25	<b>term</b> 91:10 188:22 219:13	35:3,4 37:11 40:8,21,25
117:6 122:3 132:11 158:11	<b>terminology</b> 12:17 42:4	41:1,9 45:11 51:1,2 53:19
163:16 165:7,18,19 179:21	<b>terms</b> 19:14,17 23:19 39:8	53:22 54:17,23 59:14 71:22
180:24 183:3 191:21 196:20	70:18,21 106:8 108:16,20	72:15 80:21 83:14 87:19,20
198:3 200:13 206:2,10,23	137:20 155:13 172:2,22	90:12 91:9 97:13 101:2
	195:11 245:7	106:24 107:4,13,25 108:9
	<b>test</b> 20:17,18,18 31:1 38:19	109:1 110:13,23 119:18,19

120:9 121:17 131:3 134:16 137:6 143:20 148:24 151:21 151:25 154:25 157:8 158:11 158:21 160:23 161:1 165:19 166:11 169:24 170:4,12,19 179:2 181:22,23 183:16 186:16,16 189:16 191:21 192:15 194:18 196:15 197:14 198:12 201:11,25,25 202:1 203:23 204:3,10 206:10,14 208:6 213:4 217:4,10,11 223:12 226:21 227:1 228:15,24 232:11,25 233:11,12 234:20 236:16,25 237:7 239:3 242:21 243:21 244:16 246:4 249:12,14,14 249:19 250:11,25 <b>thinking</b> 51:11 <b>thinks</b> 213:6 <b>third</b> 29:11 63:14 64:19 74:2 105:1 127:22 <b>third-party</b> 183:13,20 <b>thought</b> 45:13 49:22 133:13 154:19 170:20 182:20,24 196:8 201:10 213:9 <b>thoughts</b> 54:10,12 <b>thousand</b> 79:7 209:7 225:25 <b>thousands</b> 80:7 160:23 <b>three</b> 64:14 73:14 104:7,14 105:3 173:19 175:3 223:14 224:8 240:20,21,22 241:18 241:23,25 242:3 246:8 <b>three-year</b> 103:16 <b>thumb</b> 101:4 141:11 240:9 <b>tied</b> 118:12 155:1 157:15 234:7 <b>tight</b> 184:7 <b>tighter</b> 184:5 <b>tilling</b> 111:17 <b>Tim</b> 9:8,10 <b>time</b> 4:5 8:22 10:13,23 25:7 40:20 45:3 74:3 82:19 83:10,11 84:21 85:1 95:25 96:23 104:9 106:4,5,8,19,23 107:9,14 108:7,25 109:3	113:3 115:20,21 118:5 119:10 120:9 121:1 123:4,8 127:20 152:10,14 168:12,19 168:20 171:24 177:22 186:22 195:1,5 230:20 231:4 233:24 234:3,6 241:19 249:22,24 251:3 253:18 <b>timeout</b> 62:8 <b>times</b> 12:1 22:13 27:20 40:4 40:19 62:23 101:6 175:9,12 175:13,19 176:4 199:9,10 199:12,13,18,19,20 200:15 201:22 207:8,15,24 209:16 209:20 210:8,21 212:2 216:23 223:14 228:23 239:7 245:19,20,23 247:12,18 <b>tips</b> 66:2 <b>tissue</b> 98:17 105:12 <b>tissues</b> 65:11 <b>title</b> 171:22 172:4 <b>titled</b> 248:25 <b>today</b> 4:4 5:24 14:1 24:11 58:7 154:24 155:15,19 189:15 235:15 <b>TOLBERT</b> 1:6 <b>told</b> 10:10 30:13 91:23 118:25 148:1 211:24 <b>ton</b> 19:22 225:23,24 <b>tongue</b> 154:25 <b>tons</b> 75:1,1,1 209:7 225:9,10 225:13,20 244:22 <b>tool</b> 35:22 36:16,17,20 43:12 104:23 162:25 163:1 218:21 220:21 228:4 243:21 <b>tools</b> 78:23 84:1 157:19 220:19 <b>top</b> 14:14,20 17:2 63:12 69:9 87:22 93:7 99:18 100:12 117:18,21 128:1 132:10 171:18 187:6 223:21 230:15 236:9 237:16 244:5 <b>topography</b> 130:20 <b>total</b> 51:5 63:17 80:8,10 100:17 155:16 172:8 173:7	174:20 229:22 <b>totally</b> 39:18 50:12 <b>touched</b> 54:17 <b>track</b> 187:17 <b>trade</b> 11:24 <b>trade-offs</b> 187:1 <b>train</b> 190:13 <b>trained</b> 12:23 <b>training</b> 11:15 12:22 <b>transaction</b> 183:17 <b>transcribed</b> 253:13 <b>transcript</b> 14:8 140:10 252:5 253:17 <b>transfer</b> 41:12,20 <b>transformations</b> 118:18 <b>transition</b> 71:22 <b>translate</b> 139:11 <b>translating</b> 248:14 <b>transport</b> 29:8,10 32:22 41:23 42:19 50:16,19 52:22 55:23 81:12 82:5 83:7 99:14,15,15 112:9 131:11 138:24 155:18 157:7 162:22 184:5 191:15 192:7,8 219:18,20 221:25 224:4 <b>transportation</b> 69:13 <b>transported</b> 42:14 46:15 81:15 87:5 123:15 146:14 166:3,10 183:24 185:16 <b>transporting</b> 192:16 <b>transports</b> 76:25 <b>trap</b> 129:3 <b>treat</b> 235:22 <b>treated</b> 120:5 <b>treatment</b> 91:6 101:21 103:18 <b>treatments</b> 103:4 <b>Trevor</b> 2:5 4:9 <b>trial</b> 13:2 56:6 59:16 <b>tributaries</b> 80:12 <b>tributary</b> 26:22,23 27:8 <b>tried</b> 216:11 <b>trouble</b> 116:4 <b>troublesome</b> 187:18 <b>true</b> 16:1,8 19:15 29:25 40:9
--	--	--



40:11,12,14 60:24 87:8,11  
 87:15 89:19,21 93:14 94:4  
 94:14,21 95:4,10,20 109:19  
 111:2 114:23 115:9 147:7,9  
 153:8 154:4,16 155:14,19  
 156:24 186:14,15 187:11  
 214:11,14 252:5,7 253:17  
**truly** 147:8  
**truncate** 199:7 229:6  
**truncates** 211:14  
**TRUSTEE** 1:7  
**truth** 4:25 5:1,1 171:6 253:10  
 253:10,10  
**try** 6:21 13:15 28:11 121:25  
 164:18 186:4 189:8,9  
 198:15 215:11 238:4  
**trying** 9:1,21 10:15,22 19:18  
 20:19 23:24 40:7 41:9  
 51:25 58:10 61:11 79:19  
 87:19,20 97:17 110:15,17  
 113:13 115:17 117:16  
 129:18 148:25 154:21 159:4  
 161:22,24 166:4,13 169:25  
 186:17,18 197:24 217:5  
 232:3 233:15  
**Tucker** 2:19 4:14,14  
**Tulsa** 1:18,19 2:4,11,17  
 253:4,7  
**tune** 245:10  
**Turkey** 4:18  
**turkeys** 84:12  
**turn** 14:13 16:16 99:17 111:6  
 137:8 142:14 155:21 165:21  
 171:17 180:2 183:12 187:6  
 222:24  
**Turner** 203:22  
**Turning** 56:8  
**turns** 118:13 235:16,18  
**twelve** 119:18 120:8 121:7,10  
 122:5,17  
**twice** 146:1 223:14  
**two** 9:8 33:18 34:23 35:12  
 36:22 38:1,10 39:4,14 40:2  
 40:16 66:12,16,19 73:13  
 100:22 101:6 103:4 105:23

109:13 114:6 117:6 155:8  
 157:21 166:17 168:16 173:1  
 173:8 181:11 185:10 186:14  
 189:2,4 190:1 199:9,10,12  
 199:13,18,19,20 200:10,15  
 201:22 206:24 207:8,15,24  
 208:17 209:16,17,20,20  
 210:21 212:2 213:3 224:7  
 232:20 233:11 236:12 239:7  
 239:10,12,13,16 247:10  
**two-tenths** 174:21  
**Tylenol** 230:13  
**type** 11:5 67:2 128:23 129:4  
 129:21 163:1 188:22 201:3  
 230:23  
**types** 71:25 203:13 205:4  
**typewritten** 253:14  
**typical** 31:6 167:10 223:3  
**typically** 31:3 49:16 57:9  
 62:12,15,18,19 64:12,14  
 70:14,17 71:4 76:6 94:11  
 95:1 121:24 154:10 155:1  
 157:15 167:14 183:12  
 215:24 216:4  
**Tyson** 1:11 9:11

---

**U**

---

**ubiquitously** 178:6  
**Uh-huh** 14:17 29:16 35:9  
 36:12 37:25 38:9,11 41:21  
 42:23 46:3 51:10 54:2 60:3  
 63:19 76:2 83:5 90:8 94:3  
 98:6 100:13 103:24 106:3  
 109:8,15 113:2 114:10  
 118:1,6 119:8 121:3 128:15  
 132:13,17,23 133:9 139:3  
 144:6 167:18 168:23 172:6  
 172:18 173:11 174:5,19  
 175:21 182:18 188:6 195:8  
 196:24 197:3,10 199:2  
 202:17 203:20 206:5 208:25  
 218:5 222:25 223:24 224:23  
 227:19 232:5 234:13 235:17  
 235:20 236:2,13 239:15,19  
 240:23 242:23 244:1,4,9,23

247:25  
**UK** 153:17  
**ultimate** 157:23 158:7,10  
**unchanged** 110:4  
**undergraduate** 11:5  
**underlie** 237:14 238:2  
**underlies** 236:4  
**underline** 210:22  
**underlined** 210:21  
**underneath** 231:16 236:15  
 236:22  
**understand** 10:15,25 16:13  
 17:18 21:2 25:1 34:11  
 37:15,18,19 51:7 73:15,16  
 76:20 81:13 99:22 121:25  
 137:9 141:4 147:21 152:2  
 157:8 159:23 178:10 198:5  
 200:12 206:7,21 210:4,6  
 211:11,23 212:15 232:13  
 233:19 242:21 244:2,25  
 245:11  
**understanding** 12:8 22:17  
 23:13 24:1 50:19 52:25  
 70:13,17 71:21,24 87:15  
 88:13 99:8,13,16 116:9  
 119:14 126:15,16 135:4  
 180:10 184:18 191:21 193:9  
 223:16 233:1 245:13  
**uneven** 157:15 158:12  
**unfortunately** 95:11  
**uniform** 17:2 138:19 166:1,5  
 166:11 223:10  
**uniformly** 16:25 138:2  
 139:11 170:14 178:6  
**uninformed** 171:2  
**uninterrupted** 128:1,13  
 130:23  
**unique** 139:10  
**unit** 100:21 101:4 199:16  
 229:13,13,19 230:1 240:5  
**United** 1:1 153:15 167:11  
 191:23 192:1  
**units** 100:16 199:13 230:1,6  
 230:8 242:9,17,19  
**universally** 151:21



**universities** 156:13  
**university** 5:9,10 6:4 11:2,8,9  
 48:21 58:25 59:11 107:17  
 143:3 156:9 163:9 237:18  
**unknowingly** 170:7  
**unknown** 119:7,13  
**unlettered** 120:21  
**unmet** 61:7,17  
**unopened** 215:3 216:9  
**unreliable** 179:11  
**unusual** 87:21 108:14,19  
**updated** 151:24  
**updates** 151:16  
**uphill** 130:25  
**upper** 109:9 111:7 153:3  
 221:1  
**uptake** 69:12 90:4 113:9  
 118:20 155:9 168:1 172:7  
 173:5 174:11  
**urea** 55:21  
**USA** 153:5 157:13  
**USDA** 59:9  
**use** 12:20,23 18:11 19:3,5,6  
 19:11 22:5 23:11,16,22 24:3  
 25:11,25 27:14 28:6,19,22  
 28:24 29:18 32:12,25 33:10  
 35:8 36:19,24 41:3,24 42:1  
 42:21 43:9,14,24 44:8,12,15  
 52:1,2 54:6 70:25 91:14  
 93:25 96:9 104:22 116:10  
 116:21 121:25 122:22 136:8  
 140:20 145:11 160:2 167:16  
 182:5,8,11,13,15,25 189:8  
 189:16 192:18 195:24  
 198:15 202:7 206:15 211:20  
 211:24 212:2 217:7 230:23  
 236:24 239:6 245:6 250:2  
**useful** 117:1  
**uses** 39:10 181:13,19,25  
 182:2 188:2 189:6  
**usually** 63:2 66:1 91:15 122:1  
 123:19 227:23  
**utilization** 18:9 21:13 28:17  
 29:3,6 42:12 44:6  
**utilize** 18:17,24,25 23:6,8

25:14 29:2,12 55:20,21  
 145:10 183:11,12 192:10  
**utilized** 163:19 167:15  
 183:24 199:4 204:4 213:24  
 245:14  
**utilizing** 23:4 109:25 147:10  
 186:19 241:20  
**utmost** 186:20

---

**V**


---

**Vadas** 195:15,15,22 196:10  
 196:13,19,23 197:12 198:5  
 198:21 201:20 203:21  
 204:21 207:7 209:15 212:18  
 212:21 213:1,12,16,24,24  
 214:4,19 217:4,22  
**validated** 121:21 122:12  
**valuable** 19:4 192:10  
**value** 103:21,22 116:18 166:6  
 167:2 203:16 205:7 206:16  
 223:23 236:23 238:6,19  
**values** 160:22,25 237:14  
**variability** 95:23  
**variable** 20:1 91:1,24 144:15  
 144:18,19 145:8 157:7  
 230:3,4,5 231:19  
**variances** 103:13  
**variation** 104:7 179:18 196:4  
**varied** 67:1  
**variety** 69:2,11 137:2 187:7  
 200:9  
**various** 12:2 16:19,22 56:16  
 90:23 186:5 201:17 228:2  
**vary** 26:18  
**varying** 132:2  
**vegetation** 131:9,22  
**vehicles** 166:4  
**venture** 217:3  
**version** 151:14,15 152:1,1,1,2  
 212:11 233:19  
**versus** 67:12 109:13 210:14  
**vertical** 83:23  
**vertically** 172:11  
**VIDEOGRAPHER** 4:3,19  
 4:22 44:22 45:2 84:20,25

106:18,22 123:3,7 152:9,13  
 194:25 195:4 233:23 234:2  
 251:2  
**VIDEOTAPED** 1:14  
**view** 24:8 29:13 161:23  
 186:20 194:3 199:6 233:20  
**virtue** 1:21 24:3  
**vision** 53:14  
**Volume** 1:14 254:2  
**volumes** 137:15  
**voluntary** 185:4  
**vouch** 74:25  
**vs** 1:10  
**VSA** 148:4  
**vulnerability** 248:1

---

**W**


---

**W** 1:4 3:3  
**wait** 41:15 200:24 224:14  
**waiting** 100:3 244:13  
**wake** 140:8  
**walk** 167:4 223:18 239:20  
**walked** 14:4,5,7  
**wallets** 186:23  
**want** 12:23 19:4,6 23:10 24:8  
 24:20 25:1 35:8 36:18,18,24  
 40:11 61:4,20 64:4 110:20  
 114:4 116:2,6 117:15  
 133:17 134:11 145:9,11  
 150:4 165:14,15,22 187:15  
 194:20 204:16 206:7,8  
 209:12 245:7,10  
**wanted** 149:12  
**wants** 45:19 193:13  
**warning** 44:20  
**washes** 131:19  
**Washington** 8:15 161:11  
**wasn't** 7:21 44:2 54:10 58:4  
 79:18 121:1 169:17 175:9  
**waste** 54:5 59:18,18 72:12,19  
 74:14,15,22 76:10,15 79:2  
 83:4 85:4 87:9,17 89:20  
 94:5 98:7  
**water** 6:13,15,22,23 7:1,8,15  
 9:18,20 27:2,24 28:2 72:13

72:20,25 73:13,19,25 74:4,4 74:6,9,10,13 78:6,6,11,16 80:11 81:1,6,17,22 82:17 83:8,23 84:8,13 85:5,18,23 85:25 86:5 87:5 88:17,20 93:12 95:1 112:13,14 116:25 118:17 123:16,19,20 123:23,24 124:2,12,21 125:16,18,19,23,25 126:1,2 126:3,5,22 127:14,15,17,18 127:19 128:2,14,18 129:11 129:25 131:20,21,23 132:1 133:2 134:1,5,22 135:6 136:10,12 137:21,25 138:4 138:7,17,21 141:3,22,23 142:3,4,9 149:8 150:19 159:15,16 166:3 171:3 193:14 196:5,6,8 197:4,6,15 200:19 203:1 227:11,16 229:24,25 232:1,1 235:15 235:22 240:13 241:11 <b>waters</b> 7:6 69:14 88:9 134:1 135:2 155:18 <b>watershed</b> 16:9,12,14 21:24 22:3 23:9 26:19,20 27:1,3 27:12,13,16 28:1,2 30:1,7 30:20 32:13,20,22,23,24 33:2,4 47:11,15 48:11,23 49:1,16 55:24 56:2 60:2,6 60:13 61:2,15 62:19 67:5,11 70:10,10,19,22,25,25 72:7 72:12,13,20 73:1,6,8 74:1,4 74:23 75:18 77:2,10,22,25 79:1,10,14,24 80:2,18,22,24 81:2,9,18 82:11,23 84:11 85:5 88:9,21 89:1 90:11 92:5 94:5 99:4,10 102:7,17 120:13 121:13 124:1,19 126:14 130:2 134:20 135:15 135:19,23,24 136:2,4,13,17 136:21,24 137:4,5 138:2 139:10,12 140:16,18,22 142:8,18 143:2,7,13 144:8 144:18 147:4 148:10 149:14 154:2 155:23 157:8,20,23	158:4,6,6,8,15,16,17,18,19 159:7,10,15,19 160:6,8 161:16 162:3,9,9,17,20 163:7,11,11 164:1,11 178:7 180:25 181:21,23,24 184:15 185:16 188:5 191:10 193:4 193:6 204:12,14 211:20 219:8 221:3 250:3,10,13,19 <b>watersheds</b> 26:15 191:14 192:9,22 <b>waterways</b> 135:2,5 <b>way</b> 18:1 27:13 45:16 52:24 66:2,9 81:21 105:21 119:1 126:8 128:7 129:1,7 141:18 149:3 151:16,17 158:14 182:2 185:22,25 190:13 201:22 208:17 228:1 232:1 235:4,5,9 240:14 243:4,18 244:25 245:11 246:24 250:7 <b>ways</b> 30:19 88:7 129:18 190:1 208:17 <b>weather</b> 235:14 <b>weathering</b> 16:7 <b>weathermen</b> 231:9 <b>Webster</b> 8:11,12 9:4 10:9 <b>wedded</b> 26:9 228:11 <b>weigh</b> 243:17 <b>weight</b> 224:19,22 242:22 243:10,14 247:19 <b>weighted</b> 243:16 <b>weighting</b> 247:12 <b>weights</b> 226:6 243:3,13 <b>wells</b> 136:9 <b>went</b> 45:8 89:15 91:8 92:13 174:3 <b>west</b> 2:4,10 17:3 <b>we'll</b> 17:6 41:23 42:17 83:16 95:8 113:3 157:13 167:3 209:19 236:25 238:4 <b>we're</b> 20:5,21 21:6 24:14 37:14,15 44:22 52:22 67:3 68:7,9,14 71:22 84:20 106:18 117:6 122:2 123:3 139:21 151:14 152:9 155:12 157:19 175:16 177:22	200:12 206:22 207:13,18 208:17,20 217:12 229:6 230:13 233:23 240:24 <b>we've</b> 11:14 12:1 44:19 49:3 94:9 109:19 110:23 111:3 113:11 129:15 131:4 151:18 155:15 172:11 179:21 188:8 198:3 201:16 217:15 222:16 249:10,22 <b>WE-38</b> 137:4 <b>whatsoever</b> 86:22 <b>wide</b> 137:2 170:8 200:9 203:18 205:9 <b>widely</b> 110:24 <b>widespread</b> 187:10 <b>willing</b> 34:21 44:4 <b>wish</b> 37:21 <b>witness</b> 1:16 4:22 48:10 54:8 82:19 252:8 253:9,22 <b>wondering</b> 230:7 <b>wood</b> 125:4,7 <b>wooded</b> 125:8,10,13 <b>word</b> 60:14 97:16 110:12,14 170:17 188:12,21 <b>words</b> 16:21 122:22 129:3 146:18 179:18 <b>work</b> 6:10 8:12 10:24 14:4 22:8,10 26:9 27:1,15 32:6 42:16 59:10 73:16 115:2 117:4 134:11 152:2 186:4 191:6 195:14,15 198:6,21 204:23,24 213:1 221:20 232:14 237:21 246:24 247:3 <b>worked</b> 27:10 <b>working</b> 9:3 53:25 59:3 96:12 151:14 157:21 245:12 <b>works</b> 9:11 66:9 119:1 151:16 <b>world</b> 29:15 37:24 40:6 77:13 93:22 122:9 139:12 148:3 182:19 183:7 190:6,16 191:6 204:8 216:12 226:16 235:22 <b>worldwide</b> 191:24 192:1 <b>worms</b> 215:2,3 216:8 <b>worry</b> 53:15
--	--	---

<b>worst</b> 178:13 179:3 <b>worth</b> 29:11,13 <b>wouldn't</b> 24:8 30:4 33:8 34:17 40:21 65:2 84:16 96:15 104:18,19 124:15 141:19 160:2 162:15 190:23 197:13 223:12 225:11 227:13 <b>write</b> 57:24 94:2 <b>writing</b> 12:19 171:1 228:7 <b>written</b> 171:8 181:2 222:7,9 222:10 <b>wrong</b> 145:3 146:22 147:1 160:21 161:1 178:3,20 179:4 205:10 248:8 <b>wrote</b> 94:18,19 146:21 196:19	<hr/> <b>Z</b> <hr/> <b>zero</b> 84:7 87:13 100:18 103:18 114:18 119:24 229:3 229:4 236:11 238:5,7,12 241:6 <b>zinc</b> 15:14,18,20,25 <b>zone</b> 98:15	<b>01:41PM</b> 131:5,10,15,20,25 <b>01:43PM</b> 132:5,10,15 <b>01:44PM</b> 132:20,25 133:5 <b>01:46PM</b> 133:10,15,20 <b>01:47PM</b> 133:25 134:5,10 <b>01:48PM</b> 134:15,20,25 <b>01:49PM</b> 135:5,10,15 <b>01:50PM</b> 135:20,25 136:5,10 <b>01:51PM</b> 136:15,20,25 <b>01:52PM</b> 137:5,10,15 <b>01:53PM</b> 137:20,25 138:5,10 <b>01:54PM</b> 138:15,20 <b>01:55PM</b> 138:25 139:5,10 <b>01:56PM</b> 139:15,20,25 140:5 <b>01:57PM</b> 140:15,20,25 141:5 <b>01:58PM</b> 141:10,15,20 142:5 <b>01:59PM</b> 142:10,15 <b>02:00PM</b> 142:20,25 143:5 <b>02:01PM</b> 143:10,15,20 <b>02:02PM</b> 143:25 144:5,10,15 <b>02:03PM</b> 144:20,25 145:5 <b>02:04PM</b> 145:10,15,20,25 <b>02:05PM</b> 146:5,10,15 <b>02:06PM</b> 146:20,25 147:5,10 <b>02:07PM</b> 147:15,20,25 148:5 <b>02:08PM</b> 148:10,15,20 <b>02:09PM</b> 148:25 149:5,10,15 <b>02:10PM</b> 149:20,25 150:5 <b>02:11PM</b> 150:10,15,20 <b>02:12PM</b> 150:25 151:5,10 <b>02:13PM</b> 151:15,20,25 152:5 152:10 <b>02:21PM</b> 152:15,20 <b>02:22PM</b> 152:25 153:5,10,15 <b>02:23PM</b> 153:20,25 154:5,10 154:15 <b>02:24PM</b> 154:20,25 155:5,10 <b>02:25PM</b> 155:15,20,25 <b>02:26PM</b> 156:5,10,15 <b>02:27PM</b> 156:20,25 157:5,10 <b>02:28PM</b> 157:15,20,25 158:5 <b>02:29PM</b> 158:10,15 <b>02:30PM</b> 158:25 159:5,10,15 <b>02:31PM</b> 159:20,25 160:5 <b>02:32PM</b> 160:10,15,20,25
<hr/> <b>X</b> <hr/> <b>X</b> 3:1 202:7 208:10	<hr/> <b>0</b> <hr/> <b>01:07PM</b> 106:25 107:5,10 <b>01:08PM</b> 107:15,20,25 108:5 <b>01:09PM</b> 108:10,15,20 <b>01:10PM</b> 108:25 109:5,10 <b>01:11PM</b> 109:20,25 110:5 <b>01:12PM</b> 110:10,15,20 <b>01:13PM</b> 110:25 111:5,10 <b>01:14PM</b> 111:15,20,25 <b>01:15PM</b> 112:5,10,15,20 <b>01:16PM</b> 112:25 113:10,15 <b>01:17PM</b> 113:20,25 114:5,10 <b>01:18PM</b> 114:15,20,25 <b>01:19PM</b> 115:5,10,15,20,25 <b>01:20PM</b> 116:5,10 <b>01:21PM</b> 116:15,20,25 <b>01:22PM</b> 117:5,10,15 <b>01:23PM</b> 117:20,25 118:5,10 <b>01:24PM</b> 118:15,20,25 119:5 <b>01:25PM</b> 119:10,15,20,25 <b>01:26PM</b> 120:5,10,15,20 <b>01:27PM</b> 120:25 121:5,10 <b>01:28PM</b> 121:15,20,25 122:5 <b>01:29PM</b> 122:10,15,20,25 <b>01:30PM</b> 123:5,10 <b>01:31PM</b> 123:15,20,25 <b>01:32PM</b> 124:5,10,15 <b>01:33PM</b> 124:20,25 125:5,10 125:15 <b>01:34PM</b> 125:20,25 126:5 <b>01:35PM</b> 126:10,15,20,25 <b>01:36PM</b> 127:5,10,15,20,25 <b>01:37PM</b> 128:5,10 <b>01:38PM</b> 128:15,20,25 129:5 129:10 <b>01:39PM</b> 129:15,20,25 130:5 <b>01:40PM</b> 130:10,15,20,25	
<hr/> <b>Y</b> <hr/> <b>Y</b> 208:9 210:2 <b>yeah</b> 16:23 24:8 25:9 45:24 69:6 78:20 80:20 95:10 125:8 138:9 168:18,25 196:15 202:13 206:13 223:17 224:5 240:11 <b>year</b> 10:3,6 119:19 154:18 172:22 173:21 174:16,22 176:2 231:3 232:17,23 233:3,5,8 234:6,23 <b>years</b> 6:5 21:14 31:17 56:16 57:3 59:5 91:4 95:14 100:16,17,19 104:7,14 105:3,24 108:11 109:3 151:18,25,25 154:21,22 155:3,5 156:15 172:12 173:15,19 175:3,5,23,25 176:18 231:3,8,13,24 234:7 234:24 <b>year-to-year</b> 103:13 104:7 <b>Yesterday</b> 14:2 <b>yield</b> 109:18 173:4 174:3 <b>Yikes</b> 218:9		

<b>02:33PM</b> 161:5,10,15	<b>03:14PM</b> 189:5,10,15,20	<b>04:09PM</b> 216:5,10,15,20,25
<b>02:34PM</b> 161:20,25 162:5,10	<b>03:15PM</b> 190:5,10,15,20	<b>04:10PM</b> 217:5,15
<b>02:35PM</b> 162:15,20,25 163:5	<b>03:16PM</b> 190:25 191:5,10,15	<b>04:11PM</b> 217:20,25 218:5
<b>02:36PM</b> 163:10,15,20	<b>03:17PM</b> 191:20,25 192:5,10	<b>04:12PM</b> 218:10,15,20,25
<b>02:37PM</b> 163:25 164:5,10	<b>03:18PM</b> 192:15,20,25	<b>04:13PM</b> 219:5,10,15
<b>02:38PM</b> 164:15,20	<b>03:19PM</b> 193:5,10,15,20	<b>04:14PM</b> 219:20,25 220:5,10
<b>02:39PM</b> 164:25 165:5	<b>03:20PM</b> 193:25 194:5,10,15	<b>04:15PM</b> 220:15,20,25
<b>02:40PM</b> 165:10,15	<b>03:21PM</b> 194:20,25	<b>04:16PM</b> 221:5,10,15
<b>02:41PM</b> 165:20,25	<b>03:35PM</b> 195:5,10	<b>04:17PM</b> 221:20,25 222:5,10
<b>02:42PM</b> 166:5,10	<b>03:36PM</b> 195:15,20	222:15
<b>02:43PM</b> 166:15,20,25	<b>03:37PM</b> 195:25 196:5,10	<b>04:18PM</b> 222:20,25
<b>02:44PM</b> 167:5,10,15,20	<b>03:38PM</b> 196:15,20	<b>04:19PM</b> 223:5,10,15
<b>02:45PM</b> 167:25 168:5,10,15	<b>03:39PM</b> 196:25 197:5,10	<b>04:20PM</b> 223:25 224:5,10,15
<b>02:46PM</b> 168:20,25 169:5,10	<b>03:40PM</b> 197:15,20,25	<b>04:21PM</b> 224:20,25 225:5,10
<b>02:47PM</b> 169:15,20,25 170:5	<b>03:41PM</b> 198:5,10,15,20	<b>04:22PM</b> 225:15,20,25 226:5
<b>02:48PM</b> 170:10,15,20,25	<b>03:42PM</b> 198:25 199:5,10	<b>04:23PM</b> 226:15,20,25
<b>02:49PM</b> 171:5,10,15,20	<b>03:43PM</b> 199:15,20,25 200:5	<b>04:24PM</b> 227:5,10,15
<b>02:50PM</b> 171:25 172:5,10,15	<b>03:44PM</b> 200:10,15,20,25	<b>04:25PM</b> 227:20,25 228:5
<b>02:51PM</b> 172:20 173:5,10,15	<b>03:45PM</b> 201:5,10,15,20	<b>04:26PM</b> 228:10,15,20,25
173:20	<b>03:46PM</b> 201:25 202:5,10	229:5
<b>02:52PM</b> 173:25 174:5,10,15	<b>03:47PM</b> 202:15,20	<b>04:27PM</b> 229:10,15,20,25
<b>02:53PM</b> 174:20,25 175:5,10	<b>03:48PM</b> 202:25 203:5,10,15	<b>04:28PM</b> 230:5,10,15,20
<b>02:54PM</b> 175:15,20,25 176:5	<b>03:49PM</b> 203:20,25 204:5	<b>04:29PM</b> 230:25 231:5,10
176:10	<b>03:50PM</b> 204:10,15,20,25	<b>04:30PM</b> 231:20,25 232:5,10
<b>02:55PM</b> 176:15,20	<b>03:51PM</b> 205:5,10,15,20	232:15
<b>02:56PM</b> 176:25 177:5,10	<b>03:52PM</b> 205:25 206:5	<b>04:31PM</b> 232:20,25 233:5,10
<b>02:57PM</b> 177:15,20	<b>03:53PM</b> 206:10,15	<b>04:32PM</b> 233:15,20,25
<b>02:58PM</b> 177:25 178:5,10,15	<b>03:54PM</b> 206:20,25 207:5,10	<b>04:39PM</b> 234:5,10
<b>02:59PM</b> 178:20,25 179:5	207:15	<b>04:40PM</b> 234:15,20,25
<b>03:00PM</b> 179:10,15,20	<b>03:55PM</b> 207:20,25	<b>04:41PM</b> 235:5,10
<b>03:01PM</b> 179:25 180:5,10	<b>03:56PM</b> 208:5	<b>04:42PM</b> 235:15,20,25 236:5
<b>03:02PM</b> 180:15,20,25 181:5	<b>03:57PM</b> 208:10	236:10
<b>03:03PM</b> 181:10,15,20	<b>03:58PM</b> 208:15,20,25 209:5	<b>04:43PM</b> 236:15,20,25
<b>03:04PM</b> 181:25 182:5,10	<b>03:59PM</b> 209:10,15,20,25	<b>04:44PM</b> 237:5,10,15,20,25
<b>03:05PM</b> 182:15,20,25 183:5	<b>038</b> 208:8,12 209:23	<b>04:45PM</b> 238:5,10,15,20
183:10	<b>04</b> 103:17	<b>04:46PM</b> 238:25 239:5,10
<b>03:06PM</b> 183:15,20,25	<b>04:00PM</b> 210:5,10,15,20,25	<b>04:47PM</b> 239:15,20,25 240:5
<b>03:07PM</b> 184:5,10,15	<b>04:01PM</b> 211:5,10,15,20	<b>04:48PM</b> 240:10,15,20
<b>03:08PM</b> 184:20,25 185:5	<b>04:02PM</b> 211:25 212:5,10,15	<b>04:49PM</b> 240:25 241:5,10,15
<b>03:09PM</b> 185:10,15,20	<b>04:03PM</b> 212:20,25 213:5	<b>04:50PM</b> 241:20,25 242:5,10
<b>03:10PM</b> 185:25 186:5,10,15	<b>04:04PM</b> 213:10,15	<b>04:51PM</b> 242:15,20,25
<b>03:11PM</b> 186:20,25 187:5,10	<b>04:05PM</b> 213:20,25	<b>04:52PM</b> 243:5,10,15
<b>03:12PM</b> 187:15,20,25 188:5	<b>04:06PM</b> 214:10,15,20	<b>04:53PM</b> 243:20,25 244:5,10
188:10	<b>04:07PM</b> 214:25 215:5	<b>04:54PM</b> 244:15,20,25
<b>03:13PM</b> 188:15,20,25	<b>04:08PM</b> 215:10,15,20,25	<b>04:55PM</b> 245:5,10,15

**04:56PM** 245:20,25 246:5,10  
**04:57PM** 246:15,20,25 247:5  
 247:10  
**04:58PM** 247:20,25 248:5  
**04:59PM** 248:10,15,20,25  
**05:00PM** 249:5  
**05:01PM** 249:10,15  
**05:02PM** 249:20,25 250:5  
**05:03PM** 250:10,15,20  
**05:04PM** 250:25 251:5  
**07** 10:6,7  
**08** 178:18  
**09:04AM** 4:5,10,15,20  
**09:05AM** 5:5,10,15,20,25 6:5  
**09:06AM** 6:10,15,20,25  
**09:07AM** 7:5,10,15,20  
**09:08AM** 7:25 8:5,10,15  
**09:09AM** 8:20,25 9:5  
**09:10AM** 9:10,15,20,25  
**09:11AM** 10:5,10,15,20  
**09:12AM** 10:25 11:5,10  
**09:13AM** 11:15,20,25 12:5  
**09:14AM** 12:10,15,20,25  
**09:15AM** 13:5  
**09:16AM** 13:10,15,20,25  
**09:17AM** 14:5,10,15,20  
**09:18AM** 14:25 15:5,10  
**09:19AM** 15:15,20,25 16:5  
**09:20AM** 16:10,15,20  
**09:21AM** 16:25 17:5,10,15  
 17:20  
**09:22AM** 17:25 18:5,10,15  
**09:23AM** 18:20,25 19:5,10  
**09:24AM** 19:15,20,25 20:5  
**09:25AM** 20:10,15,20,25  
**09:26AM** 21:5,10,15,20  
**09:27AM** 21:25 22:5,10,15  
**09:28AM** 22:20,25 23:5,10  
**09:29AM** 23:15,20,25  
**09:30AM** 24:5,10,15  
**09:31AM** 24:20,25 25:5,10  
**09:32AM** 25:15,20,25  
**09:33AM** 26:5,10,15,20  
**09:34AM** 26:25 27:5,10,15  
**09:35AM** 27:20,25 28:5,10

**09:36AM** 28:15,20,25  
**09:37AM** 29:5,10,15,20  
**09:38AM** 29:25 30:5,10,15  
**09:39AM** 30:20,25 31:5,10  
**09:40AM** 31:15,20,25 32:5  
**09:41AM** 32:10,15  
**09:42AM** 32:20,25 33:5  
**09:43AM** 33:10,15,20  
**09:44AM** 33:25 34:5,10  
**09:45AM** 34:15,20,25  
**09:46AM** 35:5,10,15,20  
**09:47AM** 35:25 36:5,10,15  
**09:48AM** 36:20,25 37:5,10  
**09:49AM** 37:15,20 38:5,10  
**09:50AM** 38:15,20,25 39:5  
**09:51AM** 39:10,15  
**09:52AM** 39:20,25 40:5,10  
**09:53AM** 40:15,20,25  
**09:54AM** 41:5  
**09:55AM** 41:10,15,20,25  
 42:5  
**09:56AM** 42:10,15,20  
**09:57AM** 42:25 43:5,10  
**09:58AM** 43:15,20,25  
**09:59AM** 44:5,10,15,20

---

**1**

---

**1** 13:9 14:11 117:11 128:4,6  
 128:14,18,25 130:17 141:2  
 141:8,12,17 142:10 151:15  
 202:20,23 239:22 240:1  
**1,200** 100:19  
**1,600** 100:20  
**1.0** 224:19 234:15 242:24  
 245:17  
**1.75** 169:12  
**1:00** 106:16  
**1:08** 106:21,23  
**1:31** 123:4,8  
**10** 168:2 195:7 205:25 225:6  
 225:13,16 226:8,8,11,12  
 244:21  
**10B** 206:14  
**10C** 206:10 213:15  
**10D** 213:15

**10E** 213:15,18  
**10:01** 44:23  
**10:15** 44:25  
**10:15AM** 45:5,10,15,20,25  
**10:16** 45:3  
**10:16AM** 46:5,10,15  
**10:17AM** 46:20,25 47:5,10  
**10:18AM** 47:15,20,25 48:5  
**10:19AM** 48:10,15  
**10:20AM** 48:20,25 49:5,10  
**10:21AM** 49:15,20  
**10:22AM** 49:25 50:5  
**10:23AM** 50:10,15,20,25  
**10:24AM** 51:5,10,15,20  
**10:25AM** 51:25 52:5,10  
**10:26AM** 52:15,20,25  
**10:27AM** 53:5,10,15  
**10:28AM** 53:20,25 54:5,10  
**10:29AM** 54:15,20,25 55:5  
**10:30AM** 55:10,15,20  
**10:31AM** 55:25 56:5  
**10:32AM** 56:10  
**10:52AM** 56:15,20,25 57:5  
 57:10,15,20,25 58:5,10,15  
 58:20,25 59:5,10,15,20,25  
 60:5,10,15,20,25 61:5,10,15  
 61:20,25 62:5,10,15,20,25  
 63:5,10,15,20,25 64:5,10,15  
 64:20,25 65:5,10,15,20,25  
 66:5,10,15,20,25 67:5,10,20  
 67:25 68:5,10,15,20,25 69:5  
**10:53AM** 69:15,20  
**10:54AM** 69:25 70:5,10  
**10:55AM** 70:15,20,25  
**10:56AM** 71:5,10,15,20  
**10:57AM** 71:25 72:5,10  
**10:58AM** 72:15,20,25  
**10:59AM** 73:5,10,15,20  
**100** 2:10 40:4 61:23 62:5  
 142:23,25 156:4 238:16,17  
 238:25 248:14,16 249:1  
**11** 103:19 212:17 218:2,15  
 220:18  
**11.2** 197:4  
**11:00AM** 73:25 74:5,10,15



11:01AM 74:20,25 75:5,10 75:15	11:48AM 99:10,15,20	169:11 171:18 198:8 234:14
11:02AM 75:20,25 76:5	11:49AM 99:25 100:5,10	245:17
11:03AM 76:10,15,20,25 77:5	11:50AM 100:15,20,25 101:5	2.0 197:2
11:04AM 77:10,15,20	11:51AM 101:10,15	2.2 226:1
11:05AM 77:25 78:5,10,15 78:20	11:52AM 101:20,25 102:5,10	2:15 152:10,11
11:06AM 78:25 79:5,10,15 79:20,25	11:53AM 102:15,20,25	2:22 152:12,14
11:07AM 80:5,10,15,20,25	11:54AM 103:5,10	20 197:20 225:16,18 226:8,8 226:12
11:08AM 81:5,10,15,20	11:55AM 103:15,20,25	200 143:13 144:9 156:4,5 238:25
11:09AM 81:25 82:5,10,15	11:56AM 104:5,10,15,20	200,000 74:25
11:10AM 82:20,25 83:5,10 83:15	11:57AM 104:25 105:5	2000 2:23 154:18 155:13
11:11AM 83:20,25	11:58AM 105:10,15,20,25	2001 103:17,20,22
11:12AM 84:5,10,15	11:59AM 106:5,10,15,20	2001-2004 103:3
11:13AM 84:20	117 93:7	2002 103:20 109:14
11:14 84:21,22	119 96:24	2004 110:5 222:13
11:25AM 84:25 85:5	12 103:19 119:19 249:9	2006 7:20,24 8:8
11:26 84:23 85:1	12:00 106:19,20	2007 7:24
11:26AM 85:10,15,20,25 86:5	121 99:17	2009 1:18 4:5 252:9,18 253:23
11:27AM 86:10,15	122 101:15	21st 2:6
11:28AM 86:20,25 87:5,10	126 102:23	211 2:13
11:29AM 87:15,20,25	127 103:12	212 235:18
11:30AM 88:5,10,15	128 104:25 105:24	221 2:20
11:31AM 88:20,25 89:5	13 197:21	23059 2:23
11:32AM 89:10,15,20	132 155:21,22	24 65:23
11:33AM 89:25 90:5,10	137 222:24	25 175:13 238:5,7,12,12
11:34AM 90:15,20,25	140 173:22,23	252 3:7 253:16
11:35AM 91:5,10,15,20,25	143 156:18	253 3:7
11:36AM 92:5,10,15	1492 109:7	26 153:12 157:12
11:37AM 92:20	1493 111:7 114:15	268 135:21
11:38AM 92:25 93:5,10,15	15 103:21 104:3 239:23 240:1	272 137:8
11:39AM 93:20,25 94:5,10	15th 1:17 4:5	274 142:14
11:40AM 94:15,20,25 95:5	16 240:1	
11:41AM 95:10	170 231:16,25 232:9	3
11:42AM 95:15,20,25 96:5	180 173:20	3 14:13 92:16 141:9,19 152:1 166:18 167:11 168:6 198:24 199:1
11:43AM 96:10,15,20	19 175:9,12 207:2,19 208:1 208:20 209:14,20 211:3	3A 14:15
11:44AM 96:25 97:5	19th 253:22	3F 56:20
11:45AM 97:10,15	1991 106:2 175:9	3,000 39:6
11:46AM 97:20,25 98:5,10 98:15	1992 175:13	3:22 195:1,2
11:47AM 98:20,25 99:5	1993 175:16	3:36 195:3,5
	1995 117:4	30 35:13 36:11 39:6 139:1,14 140:21 141:3,6,13 225:18
	1996 133:25	
	2	
	2 57:21 99:18 128:5,7,7,25 141:9 142:10 151:15 152:1	



225:20 226:8,9 232:18 233:5,10,16 <b>30,000-foot</b> 6:9,10 <b>30-meter</b> 139:9 <b>300</b> 35:13 36:11 221:4,6 <b>300,000</b> 75:1 <b>313</b> 2:6 <b>32</b> 235:15 <b>320</b> 2:16 <b>33</b> 103:1,8 <b>37</b> 165:5 <b>377</b> 167:3 <b>378</b> 166:14 <b>38</b> 206:16,23 208:8,15 209:21 209:22 <b>380</b> 171:17 <b>386</b> 180:2 187:6 253:24 <b>389</b> 169:10 <b>39</b> 175:19 <b>39225</b> 2:24	<b>5C</b> 89:9,23 92:18 <b>5F</b> 132:3 <b>5G</b> 132:10 <b>5H</b> 152:17 <b>5th</b> 2:10 <b>5.9</b> 174:15 <b>5:05</b> 251:3,5 <b>50</b> 134:3 238:13,16 239:5 248:12,12 249:1 <b>502</b> 2:4 <b>576</b> 198:24 <b>578</b> 202:15 <b>590</b> 184:19,22 220:22 221:7 250:16,18	<b>8</b> <b>8</b> 132:10 196:17 <b>8.1</b> 165:11 <b>800</b> 100:19 101:13 <b>89</b> 172:14 173:15
<b>4</b> <b>4</b> 22:22 54:18 107:10 108:21 141:19 152:1 223:1,3 <b>4A</b> 14:21 <b>4B</b> 62:25 <b>4C</b> 65:7 69:8,9 <b>4:05-CV-00329-TCK-SAJ</b> 1:10 <b>4:33</b> 233:24,25 <b>4:40</b> 234:1,3 <b>40</b> 103:2,8 143:12 144:8 168:2 197:22 <b>400</b> 2:10 100:18 <b>400,000</b> 75:1 <b>403</b> 101:8,9 <b>45</b> 240:1 <b>46</b> 240:2	<b>6</b> <b>6</b> 63:12 65:7 85:10 87:2 89:25 117:20 152:16 164:20,21 222:22 <b>6E</b> 213:20,21 <b>6th</b> 2:4 <b>6.4</b> 174:15 <b>60</b> 134:4 142:21 143:7 144:5 <b>65</b> 61:18 62:5 249:2	<b>9</b> <b>9</b> 164:21 214:16 <b>9:04</b> 4:2 <b>9:05</b> 4:5 <b>9:59</b> 44:24 <b>90</b> 172:14 173:16 <b>91</b> 172:17 175:5 <b>92</b> 172:17 175:5 <b>93</b> 172:17 175:5,24 <b>94</b> 172:19 173:25 175:24 <b>96</b> 134:8 <b>99</b> 172:19 173:25
<b>5</b> <b>5</b> 3:5 56:8 63:1 85:8 133:11 135:14 152:2 166:1,6,11,22 169:15,17,20,21 170:5 171:14 178:5,9,19 243:2 <b>5B</b> 87:2	<b>7</b> <b>7</b> 103:21 104:3 117:12,21,22 123:9 132:3 165:17 166:14 179:22 218:2,6,15 244:24 245:3 <b>7B</b> 195:7 220:17 <b>7C</b> 205:24 <b>7E</b> 212:17 <b>7H</b> 133:7 <b>7-11</b> 218:16 <b>7-11B</b> 220:17 <b>7-11C</b> 249:9 <b>700</b> 2:17 <b>72701</b> 2:14,20 <b>73105</b> 2:7 <b>74103</b> 2:11,17 <b>74119</b> 2:4 <b>75</b> 240:2 243:1 <b>76</b> 240:2	

IN THE UNITED STATES DISTRICT COURT FOR THE  
NORTHERN DISTRICT OF OKLAHOMA

W. A. DREW EDMONDSON, in his )  
capacity as ATTORNEY GENERAL )  
OF THE STATE OF OKLAHOMA and )  
OKLAHOMA SECRETARY OF THE )  
ENVIRONMENT C. MILES TOLBERT, )  
in his capacity as the )  
TRUSTEE FOR NATURAL RESOURCES )  
FOR THE STATE OF OKLAHOMA, )

Plaintiff, )

vs. ) 4:05-CV-00329-TCK-SAJ

TYSON FOODS, INC., et al, )

Defendants. )

- - - - -

VOLUME II OF THE VIDEOTAPED  
DEPOSITION OF FRANK COALE, PhD, produced as a  
witness on behalf of the Plaintiff in the above  
styled and numbered cause, taken on the 16th day of  
January, 2009, in the City of Tulsa, County of  
Tulsa, State of Oklahoma, before me, Lisa A.  
Steinmeyer, a Certified Shorthand Reporter, duly  
certified under and by virtue of the laws of the  
State of Oklahoma.

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25

# A P P E A R A N C E S

FOR THE PLAINTIFFS: Mr. Robert Nance  
Mr. David Page  
Attorneys at Law  
502 West 6th Street  
Tulsa, OK 74119

FOR CARGILL: Ms. Theresa Hill  
Attorney at Law  
100 West 5th Street  
Suite 400  
Tulsa, OK 74103

FOR PETERSON FARMS: Mr. Scott McDaniel  
Attorney at Law  
320 South Boston  
Suite 700  
Tulsa, OK 74103

FOR GEORGES: Ms. K. C. Tucker  
Attorney at Law  
221 North College  
Fayetteville, AR 72701

FOR CAL-MAINE: Mr. Robert Sanders  
Attorney at Law  
2000 AmSouth Plaza  
P. O. Box 23059  
Jackson, MS 39225  
(Via phone)

255

(Whereupon, the deposition began at  
9:05 a.m.)

VIDEOGRAPHER: We are now on the Record for  
Volume II of the deposition of Dr. Frank Coale.  
Today is January 16th, 2009. The time is 9:05 a.m. 09:03AM  
Would counsel please identify themselves for the  
Record?

MR. NANCE: Bob Nance for the State of  
Oklahoma.

MR. PAGE: David Page for the State of 09:03AM  
Oklahoma.

MR. McDANIEL: Scott McDaniel for Peterson  
Farms, Inc.

MR. TUCKER: K. C. Tucker for the George's  
defendants. 09:04AM

MS. HILL: Theresa Hill for the Cargill  
defendants.

VIDEOGRAPHER: And on the phone?

MR. SANDERS: Bob Sanders for the Cal-Maine  
defendants. 09:04AM

FRANK COALE, PhD  
having first been duly sworn to testify the truth,  
the whole truth and nothing but the truth, testified  
as follows:

CONTINUED DIRECT EXAMINATION

257

1  
2  
3  
4  
5  
6  
7  
8  
9  
10  
11  
12  
13  
14  
15  
16  
17  
18  
19  
20  
21  
22  
23  
24  
25

# I N D E X

WITNESS	PAGE
FRANK COALE, PhD	
Continued Direct Examination by Mr. Nance	257
Signature Page	369
Reporter's Certificate	370

256

BY MR. NANCE:  
**Q Good morning, Dr. Coale.**  
A Good morning.  
**Q If you would take your report, which is**  
**Exhibit 1 in front of you, and please turn to Page 09:04AM**  
**12.**  
A Okay.  
**Q Let us -- let's look at the middle of that**  
**Subparagraph D, which I guess is 7-11D, although**  
**it's on Page 12. About in the middle of that 09:04AM**  
**paragraph there's a sentence which says, the**  
**objective of the P index approach is not to conduct**  
**a quantitative analysis of the specific load, i.e.,**  
**pounds per acre, of phosphorus that will be**  
**transported off a particular farm field but rather 09:05AM**  
**to provide an estimate of the relative risk of P**  
**loss when comparing multiple fields within a**  
**watershed. Did I read that correctly?**  
A Yes, you did.  
**Q Okay. So the P index isn't supposed to tell 09:05AM**  
**us how much phosphorus will wash off a particular**  
**field?**  
A That's correct.  
**Q Okay, and the risk for P loss occurs because**  
**you are putting on phosphorus in excess of the 09:05AM**

258

1 amount that's agronomically needed?  
2 MR. McDANIEL: Object to the form.  
3 A You can have a risk of P loss regardless of  
4 how the land is managed, whether there's been  
5 phosphorus added to the farm field or not. 09:05AM  
6 Q Okay, but a phosphorus index -- does a  
7 phosphorus index allow you to apply litter when the  
8 agronomic need for phosphorus on a field has already  
9 been attained?  
10 A Some sites, that can be the outcome. Other 09:06AM  
11 sites, it is not. It really depends on all the  
12 factors you consider when going through a phosphorus  
13 index evaluation.  
14 Q All right. When you say at the end of that  
15 sentence that it's to estimate the relative risk of 09:06AM  
16 P loss, what do you mean by relative risk?  
17 A When you take a particular site and you go  
18 through the phosphorus index assessment, the outcome  
19 of that assessment is a numerical scale, and it's  
20 roughly one to a hundred scale, and the higher the 09:06AM  
21 value of that outcome is interpreted to be a higher  
22 risk phosphorus loss from that site.  
23 Q So would I be correct in concluding if you had  
24 two fields and Field A had an index of 80 and Field  
25 B had an index of 50, the Field A would have a 09:06AM  
259

1 higher relevant risk?  
2 A That's correct.  
3 Q You're comparing the risk between two fields?  
4 A Correct.  
5 Q Or between subfields in a particular field? 09:06AM  
6 A Exactly right.  
7 Q Okay. Is there any conceptual reason, Dr.  
8 Coale, why you can't use it, the phosphorus index,  
9 to compare multiple fields between watersheds?  
10 A It's meant to be used on a single field basis 09:07AM  
11 or subfield basis. So you wouldn't want to group  
12 multiple fields together.  
13 Q But if Field A were in one watershed and Field  
14 B were in another, is there any reason why you can't  
15 compare the relative risk between those two fields? 09:07AM  
16 A That would be valid.  
17 Q Okay. Other than the farmer or the person  
18 wanting to apply litter, is there anyone overall  
19 comparing phosphorus index ratings within a whole  
20 watershed? 09:07AM  
21 A I'm not sure I understand the question.  
22 Q Well, a farmer or someone who is wanting to  
23 apply litter is going to look at Field A or Field B.  
24 A Right.  
25 Q Is there anybody looking at all of the fields 09:08AM  
260

in a watershed and saying, well, it's best to put  
the litter on Field L or M instead of A or B?  
MR. McDANIEL: Object to the form.  
A Not that I know of.  
Q Okay. Are you aware of anyone that's doing 09:08AM  
that for the Illinois River watershed?  
MR. McDANIEL: Object to the form.  
A No, I'm not.  
Q Are you able to express an opinion about the  
extent to which use of either Oklahoma Code 590 on 09:08AM  
our side of the border or the Arkansas phosphorus  
index on the Arkansas side of the border has reduced  
STP levels in the Illinois River watershed?  
MR. McDANIEL: Object to the form.  
A No, I can't. 09:08AM  
Q Okay. Are you able to express an opinion  
about the extent to which either Code 590 in  
Oklahoma or the Arkansas phosphorus index in  
Arkansas has improved water quality in the Illinois  
River watershed? 09:09AM  
MR. McDANIEL: Object to the form.  
A No, I can't.  
Q Do you know if anyone on behalf of the  
defendants will opine either on reductions of STP or  
improvement of water quality in the watershed 09:09AM  
261

because of those two phosphorus indices?  
MR. McDANIEL: Object to the form.  
A I have no knowledge of that.  
Q In I guess it's Paragraph 8A there at the  
bottom on Page 12, you say that there's a common set 09:09AM  
of principles that underpin phosphorus indices  
nationwide, paraphrasing. What are the common  
principles that exist between Oklahoma, Arkansas and  
Maryland in the phosphorus indices?  
A The common principles that are in all of 09:10AM  
those, they incorporate an assessment of the  
phosphorus source characteristics and the transport  
characteristics, and combine those two assessments  
and give an overall risk evaluation.  
Q Okay, and all of them do those things? 09:10AM  
A Yes.  
Q Okay. Now, in your case study that is the  
subject of Paragraph 8 and its subparts, you  
combined phosphorus index results from many sites  
and many watersheds in the state of Maryland? 09:10AM  
A Correct.  
Q So that's -- your data there was just not  
restricted to a particular watershed?  
A No.  
Q And you consider that to be a valid use of the 09:10AM  
262

1	<b>phosphorus index to do that in Maryland?</b>		each other. That three times the agronomic limit	
2	MR. McDANIEL: I object to the form.		environmental threshold was established by state	
3	A Well, we did that to demonstrate how it would		policy as a threshold that if a soil test phosphorus	
4	perform over a wide landscape. That was the		level of a certain fields is above that threshold,	
5	purpose. 09:11AM		then that site must be assessed by the phosphorus	09:13AM
6	<b>Q And would it presumably also apply over a wide</b>		site index.	
7	<b>landscape in Oklahoma or Arkansas?</b>		<b>Q Okay, and that was some sort of legal or</b>	
8	MR. McDANIEL: Object to the form.		<b>political decision made by policymakers?</b>	
9	A I believe you could apply an index over a wide		A Correct.	
10	landscape and have a similar distribution analysis. 09:11AM		<b>Q Okay, but the environmental threshold where</b>	<b>09:14AM</b>
11	<b>Q Okay, and even though that might embrace</b>		<b>you must use it is three times agronomically?</b>	
12	<b>numerous watersheds in either Oklahoma or Arkansas?</b>		A By state policy.	
13	A Watersheds are composed of subwatersheds, and		<b>Q By state policy?</b>	
14	it depends on where you draw the boundary, yes, sir.		A State regs, yes.	
15	<b>Q Well, for purposes of my question, I'm asking</b>	<b>09:11AM</b>	<b>Q Is there any empirical scientific basis that</b>	<b>09:14AM</b>
16	<b>for watersheds bigger than the Illinois River</b>		<b>says more bad things happen above that three times</b>	
17	<b>watershed, the adjoining watersheds in either state.</b>		<b>limit than happen below it?</b>	
18	A And that's something I don't have any		A Well, that limit was set based on some data	
19	knowledge how the physical topography changes. For		that was available showing that at roughly -- it was	
20	example, there's a certain place across the 09:11AM		a very rough dataset -- roughly at that level you	09:14AM
21	landscape where the soils type -- soil types may		tend to see an acceleration in soluble P in soils.	
22	change dramatically, may run from an acidic soil to		<b>Q So am I hearing you correctly that above that</b>	
23	a calcareous type soil as you work west, and I don't		<b>limit roughly --</b>	
24	know how large the landscape is or where that		A Right.	
25	boundary would be. So there's some fundamental	09:12AM	<b>Q -- there is an even greater concentration in</b>	<b>09:14AM</b>
	263		265	
1	factors there that the P index that you are		<b>runoff of soluble P than below it?</b>	
2	utilizing wouldn't be the appropriate one to use if		A I didn't say runoff. It's just soluble soil	
3	you cross a certain physical characteristic boundary		P, which is different than runoff soluble soil --	
4	in the landscape.		soluble P.	
5	<b>Q And if you cross such a boundary, would you</b>	<b>09:12AM</b>	<b>Q What's the effect of the runoff soluble P</b>	<b>09:15AM</b>
6	<b>need to somehow adjust the index to account for the</b>		<b>above and below the limit?</b>	
7	<b>difference?</b>		A If there -- if you have a higher level of	
8	A It would have to be accounted for.		soluble soil P and you have runoff generated from	
9	<b>Q Okay. I think we talked yesterday about the</b>		that site, you would expect to have higher soluble P	
10	<b>recognized agronomic limits in Maryland and</b>	<b>09:12AM</b>	in the runoff. 09:15AM	
11	<b>Oklahoma. I don't recall if we talked about what</b>		<b>Q And does the line somewhere near that point</b>	
12	<b>the agronomic limit is considered to be in Arkansas,</b>		<b>get steeper?</b>	
13	<b>and if we did, I apologize, but let me ask you that.</b>		A Exactly.	
14	A I don't recall what it is.		<b>Q Okay.</b>	
15	<b>Q Okay. Are you aware of any regulatory effort</b>	<b>09:12AM</b>	(Whereupon, a discussion was held off	
16	<b>in Oklahoma to establish an environmental threshold</b>		the Record.)	
17	<b>that is three times the 65 pound per acre agronomic</b>		<b>Q Do I understand correctly, Dr. Coale, that at</b>	
18	<b>limit in Oklahoma?</b>		<b>double, triple or quadruple the agronomic limit,</b>	
19	A No, I'm not.		<b>you're not going to get any more response from</b>	
20	<b>Q And for purposes of the Maryland site</b>	<b>09:13AM</b>	<b>phosphorus, from adding additional phosphorus?</b>	<b>09:15AM</b>
21	<b>phosphorus index, however it goes --</b>		A Response in what?	
22	A Correct.		<b>Q In forage.</b>	
23	<b>Q -- you consider high P to be three times your</b>		A In crop production, crop growth?	
24	<b>agronomic limit; do I understand that correctly?</b>		<b>Q Right.</b>	
25	A Well, let me make sure we're understanding	09:13AM	A Correct. 09:16AM	
	264		266	

1 Q Okay. That's what the agronomic limit means?  
2 A That's how it's defined.  
3 Q Okay. Does the State of Arkansas have an  
4 environmental threshold for phosphorus?  
5 A That I don't know. 09:16AM  
6 Q You don't know how it works in their  
7 phosphorus index?  
8 A I haven't studied that deeply, no, sir.  
9 Q Okay. Is it permissible in Maryland to use  
10 the Maryland site phosphorus index below the 09:16AM  
11 environmental limit or threshold?  
12 A Yes, absolutely.  
13 Q You gave me some figures yesterday on how you  
14 broke out the categories in the Maryland phosphorus  
15 index. Where would 65 pounds per acre fit in your 09:16AM  
16 categories of low, medium, optimum and excessive?  
17 A Okay. Now, those categories of low, medium,  
18 optimum and excessive we talked about yesterday were  
19 not phosphorus site index categories. Those were  
20 soil test lab report categories. 09:17AM  
21 Q Okay, and I'm wondering where from the soil  
22 test lab result of 65 pounds per acre would fit in  
23 those categories?  
24 A Well, 65 pounds per acre, using the Oklahoma  
25 conversion, would be, what, 32 and a half parts per 09:17AM  
267

1 million.  
2 Q Sounds good to me.  
3 A I believe it's a factor of half.  
4 Q Right.  
5 A So it would be 32 and a half, which would be 09:17AM  
6 in the medium category.  
7 Q Let's look at Figure 2 on Page 13 of your  
8 report. This is a result of, do I understand  
9 correctly, 646 different PI applications --  
10 A Correct. 09:18AM  
11 Q -- in the state of Maryland?  
12 A Correct.  
13 Q And it includes both sites that are above and  
14 below the environmental threshold?  
15 A Correct. 09:18AM  
16 Q Let's turn over to Page 15 and look at Figure  
17 3. How does Figure 3 differ from Figure 2?  
18 A This is a subset. This data is a subset of  
19 data that's in Figure 2.  
20 Q And is it a subset of the phosphorus index 09:19AM  
21 applications where the soil test P exceeded 150  
22 milligrams per kilogram?  
23 A That's correct.  
24 Q And for those of us who speak Oklahoman, that  
25 would be 300 pounds per acre; is that right? 09:19AM  
268

A That would be -- using the Oklahoma  
conversion, yes, sir.  
Q Okay, and if in the nutrient limited watershed  
of the Illinois River --  
A Uh-huh. 09:19AM  
Q -- there was a 300-pound per acre limit --  
A Limit to --  
Q -- phosphorus application?  
A So you can't put any more phosphorus on the  
land? 09:19AM  
Q Correct. That's your understanding of what  
our 590 says, isn't it?  
A That's my understanding, yes, sir.  
Q Okay. None of those 292 applications would be  
allowed in the Illinois River watershed, would they? 09:19AM  
A Using the Oklahoma 590 standard with its -- to  
make sure I'm understanding everything correctly,  
with the limitation drawn at 300 pounds per acre,  
that equates to all of these sites. So all these  
sites would be not -- would not be permitted to 09:20AM  
apply phosphorus on those sites.  
Q And using your phosphorus index on these -- on  
the data on these sites, how many or what percentage  
of these sites in Maryland could receive additional  
litter? 09:20AM  
269

A 94 percent.  
Q Okay. Let's just go through each of these  
categories so I understand a little better. The low  
category, which represents 55 percent of the  
samples -- 09:20AM  
A Correct.  
Q -- what would the litter application rate be  
for those low samples under your Maryland site  
index?  
A It would be the rate that was necessary to 09:20AM  
supply the nitrogen demand of the crop. So it would  
be the nitrogen-based rate.  
Q Would the application rate be for the medium  
category, which is 25 percent of the sites?  
A That would be -- it's a transitional phase in 09:21AM  
the medium where you would -- without looking at my  
reference, I hope I get this right. You can apply  
nitrogen-based rate one year or two years and then  
the phosphorus-based rate one or two years out of a  
three-year cycle, and that's why I'm hesitating 09:21AM  
whether it's one year or two years, but some years  
you apply nitrogen rate and some years you apply a  
phosphorus-based rate in a three-year crop cycle.  
Q Okay. What about the high category, which is  
15 percent of the samples? 09:21AM  
270



1 A That would be the -- the rate would  
2 be dependent -- the rate is limited to a phosphorus  
3 removal rate, a phosphorus-based rate.

4 **Q And explain to me very simply how you figure**  
5 **out phosphorus removal. 09:21AM**

6 A It would be the rate of phosphorus that's  
7 expected to be removed from the harvested crop, by  
8 the harvested crop, and that's harvested and removed  
9 from the field. The amount of phosphorus we harvest  
10 it with is the amount you should be able to apply. 09:22AM

11 **Q And the point of that would be to keep the**  
12 **phosphorus at least in balance?**

13 A To keep it steady, yes, sir.

14 **Q Then what could be applied in terms of litter**  
15 **in the very high category, which is 6 percent? 09:22AM**

16 A There would be no application.

17 **Q For those 75 percent of these samples, which**  
18 **are either low or medium, would you expect that the**  
19 **application of litter would increase the STP?**

20 MR. McDANIEL: I think it's 80 percent. 09:23AM

21 A It's 80 percent. I was just checking the  
22 math.

23 **Q Your math is correct.**

24 A All right. 80 percent, I would expect if you  
25 applied litter on those sites, the STP would 09:23AM

271

1 increase.

2 **Q Okay. Is there any phosphorus index, Dr.**  
3 **Coale, which exists, which would achieve what you do**  
4 **in the high category, which is balance inputs with**  
5 **removals, on a whole watershed basis? 09:23AM**

6 A Not that I'm aware of.

7 **Q And if something existed in your field, you**  
8 **would be aware of that, wouldn't you?**

9 A It's a high probability.

10 **Q Okay. Speaking in the very broad strokes, Dr. 09:24AM**  
11 **Coale, would you expect water quality in the**  
12 **Illinois River watershed to improve if the STPs in**  
13 **the watershed decreased?**

14 MR. McDANIEL: Object to the form. It's  
15 outside of the scope of the opinions offered in this 09:24AM  
16 report.

17 A I don't have an opinion on that.

18 **Q Are you telling me that because you haven't**  
19 **been asked to form an opinion by the defendants or**  
20 **just because you don't know? 09:24AM**

21 A No. I don't understand the water quality  
22 parameters in the watershed here.

23 **Q I'm not asking about our water quality**  
24 **standards or anything like that. I'm just asking**  
25 **about the quality of the water generally. I'm not 09:25AM**

272

**holding you to what Oklahoma water quality standards**  
**are or Arkansas.**

MR. McDANIEL: Again, I object. It's  
outside the scope of his report.

A Okay. Not being a limnologist, not being a 09:25AM  
surface water biologist, I just don't want to go in  
that area. I don't feel comfortable with that.

**Q Is that something you teach your students in**  
**your environmental science classes?**

A No. 09:25AM

**Q You don't teach them that?**

A Casual concepts but nothing very specific.

**Q Well, let's deal with it at the level of**  
**casual concepts that you teach your environmental**  
**science students at the University of Maryland. 09:25AM**

A Okay.

**Q If we were to decrease the STPs in the land of**  
**the Illinois River watershed, would you expect that**  
**to have a water quality benefit to the waters of the**  
**watershed? 09:25AM**

MR. McDANIEL: I still object. You're  
badgering him trying to get him to form an opinion  
in an area for which he's not been offered in this  
case. It's been pointed out to you twice already.

**Q Let me reframe the question, Dr. Coale. If we 09:25AM**  
**273**

**were to reduce the STP levels in the watershed on**  
**the level of what you teach your students at the**  
**University of Maryland, would you expect to decrease**  
**the P levels in the water of the Illinois River**  
**watershed? 09:26AM**

MR. McDANIEL: It's the same objection.  
It's outside the scope of his report.

A What we hopefully get across to the students  
is the importance of knowing how any nutrient or any  
substance that you're interested in is transported 09:26AM  
across a watershed, and if the substance you're  
interested in, whether it be phosphorus or nitrogen  
or some industrial chemical or whatever it is, is  
moved from where it is deposited through the  
landscape and into the water and it's been 09:26AM  
documented that it can have an ecological impact in  
the water, the important thing the students need to  
know is if it was moved across the landscape and  
transported from where it's deposited into the water  
and it's been documented that it can have an 09:27AM  
ecological impact, that you need to understand the  
source, the transport and the impact, all three  
phases of the system. Okay? If I don't know any  
one of those three phases, I don't know if it's  
going to have an impact or not. That's the level of 09:27AM

274

1 concept you would present it at.  
2 **Q Okay. Thinking of it at the PhD level where**  
3 **you are --**  
4 A Okay.  
5 **Q -- if you diminish the STPs in the Illinois 09:27AM**  
6 **River watershed, would you expect that to diminish**  
7 **the amount of phosphorus in the water of the**  
8 **Illinois River watershed?**  
9 MR. McDANIEL: Just a second. Bob, you've  
10 asked him like six different times around this 09:27AM  
11 question. I've told you he's not being presented as  
12 a water quality expert, and it's inappropriate for  
13 you to try to ask him to create opinions about the  
14 Illinois River watershed that he hasn't placed in  
15 his report. It's the fifth time now. I'll ask you 09:27AM  
16 to stop because you're arguing with and trying to  
17 badger this witness, and it's not appropriate.  
18 MR. NANCE: No, I'm not. I'm just asking  
19 him, as the expert, if he has an opinion on whether  
20 lower STPs in the soil will result in lower 09:28AM  
21 phosphorus in the water.  
22 MR. McDANIEL: And he's answered your  
23 question by saying he's not qualified, doesn't have  
24 the information, can't answer it, and you haven't  
25 accepted it. That's my problem. 09:28AM

275

1 **Q Are you not qualified to answer that question?**  
2 A That's true.  
3 **Q Okay. You said something I think earlier in**  
4 **your report about nitrogen tests not being reliable**  
5 **or something like that. Do you recall that? We can 09:28AM**  
6 **find it if we need to, but I just want to know what**  
7 **your view of nitrogen soil testing is.**  
8 A In the conventional concept of soil testing  
9 where you test the soil before you are making a  
10 management decision to see how much, for example, 09:29AM  
11 phosphorus, to see how much soil test phosphorus is  
12 in the soil, use that information to make management  
13 about what I want to do over the future, a year, two  
14 years or whatever it might be. Nitrogen  
15 concentrations in the soil are so dynamic and 09:29AM  
16 variable and transient, that it's very difficult to  
17 take a planting time frame soil sample for nitrogen  
18 and project how I should plan my management of that  
19 field according to that sample.  
20 **Q Are there nitrogen soil tests that are useful 09:29AM**  
21 **in planning one year out?**  
22 A It really depends on the more rainfall a site  
23 receives, the less useful they become. In more dry,  
24 more arid environments they become more useful. On  
25 the -- in the heavy rainfall East Coast region, they 09:29AM

276

become almost useless.  
**Q What about in the Illinois River watershed?**  
A I would -- from what I know about the  
precipitation patterns, which is just casual  
observation of data in that area, I expect they 09:30AM  
would have very limited usability.  
**Q Explain then what you -- how you form your**  
**nitrogen target, as it were, for what you need to**  
**apply.**  
A In those situations you're usually basing your 09:30AM  
nitrogen application rate based on the expected  
productivity or the yield goal or the expected  
growth that the crop is going to have, and from  
calibrated research studies, you say if you are  
going to grow X tons of grass forage, you are 09:30AM  
probably going to need so many pounds of nitrogen to  
produce that.  
**Q Okay. Let's look briefly at Figure 4 on Page**  
**16 of your report, sir. Is this a subset of your**  
**original Figure 2, which includes sites that had a 09:31AM**  
**soil test phosphorus of less than 150 milligrams per**  
**kilogram?**  
A That's what this says, yes.  
**Q And so this would be, speaking Oklahoman, less**  
**than 300 pounds per acre -- 09:31AM**

277

A Correct.  
**Q -- of phosphorus? Okay. To what do you**  
**attribute the fact that there are more sites in**  
**terms of percentage in the low category of Figure 4**  
**than Figure 3? 09:31AM**  
A Well, the only overarching differences is the  
soil test P levels.  
**Q I notice that you have, I guess, fewer in the**  
**medium category below 150 milligrams per kilogram**  
**than you did above. Am I reading that correctly? 09:32AM**  
A Yes, sir.  
**Q Comparing 13 and 25 percent?**  
A Correct.  
**Q 13 being the lower STP level. You also have**  
**fewer high risk soils being 4 percent below 150 09:32AM**  
**versus 15 percent above 150?**  
A Yes.  
**Q And you also have about half as many in the**  
**very high category when your STP is below 150; is**  
**that right? 09:32AM**  
A That's correct.  
**Q 3 versus 6 percent?**  
A That's right.  
**Q Looking there still on Page 16, you got this**  
**Paragraph 9. The last sentence of your paragraph 09:32AM**

278

1 you say, the scientific community has reached  
2 consensus that to blindly ignore either the source  
3 or transport components used to identify the  
4 critical source areas for P losses would be  
5 negligent, and then you cite Maguire, et al, and the 09:33AM  
6 SERA-17 website. Can you help me figure out where  
7 Maguire says that because I looked on the website,  
8 and I found one article, and I'll show you the  
9 article I found. It's the one we talked about at  
10 the preliminary injunction hearing. Is this the 09:33AM  
11 article that you're talking about there where  
12 Maguire says it would be negligent? That's just a  
13 separate copy of the same thing.  
14 A A quick read through this article, I don't see  
15 it. 09:37AM  
16 Q Well, and I'll tell you I didn't see it  
17 either. Is there some other article by Maguire  
18 where he says that it would be negligent to blindly  
19 ignore either source or transport components?  
20 A Not that I'm aware of. 09:37AM  
21 Q So is the word negligent your word or is it  
22 Maguire's word?  
23 A It may be my word.  
24 Q Okay. Is there anything preventing you from  
25 knowing whether it's your word or not? 09:37AM

279

1 A I -- it may be my interpretation of his  
2 writing.  
3 Q Okay. Would you read into the Record just the  
4 title of the article we've been talking about? I  
5 can make it an exhibit if we want to. 09:37AM  
6 A Title is Phosphorus Indices to Predict the  
7 Risk For Phosphorus Losses.  
8 Q Okay. Do you remember discussing that article  
9 with me during the preliminary injunction hearing?  
10 A I believe we did talk about it. 09:38AM  
11 Q Okay. Dr. Coale, negligent strikes me as a  
12 lawyer word rather than a soil scientist word. Was  
13 that word suggested to you by a lawyer?  
14 A No, sir.  
15 Q You came up with that all on your own? 09:38AM  
16 A Yes, sir.  
17 Q How many expert reports have you prepared in  
18 your career?  
19 A One.  
20 Q And that would be the one we're talking about 09:38AM  
21 today?  
22 A Yes, sir.  
23 Q How did you know how to prepare that report?  
24 A I asked a lot of questions.  
25 Q To whom did you ask them? 09:38AM

280

A The attorneys I was working with.  
Q And who were those attorneys?  
A Mainly from Mr. McDaniel.  
Q Any other attorneys?  
A There were some conference calls where there 09:38AM  
were multiple attorneys on the line, and I'm not  
sure all of them who were on the line.  
Q Was it Mr. McDaniel that told you the format  
to use?  
A Well, I believe when I first made my first 09:39AM  
draft of it, my first cut of it, it was essentially  
one long paragraph, and I was advised to break it up  
into an outline-type paragraph format to make it so  
we could reference section by section more clearly.  
Q Did the substance of what you wrote change as 09:39AM  
you went through drafts?  
A As I edited it, yes, sir.  
Q Did any lawyer help you edit it?  
A We had -- in a couple of instances had web  
conferences and looked at drafts, and I got feedback 09:39AM  
on whether what I was writing made sense to a more  
general body audience and, yes, there was  
suggestions made that, you know, this is a clear  
message, this is not a clear message, and I would  
adjust it from there. 09:39AM

281

Q Okay. Tell me what you mean when you say you  
had a web conference.  
A It was my first experience with that as well.  
It was called a WebEx, where a website hosted the  
ability to -- I would bring document up on my 09:40AM  
computer and whoever was in on that web conference  
could see what was -- my document said.  
Q Who was on that conference with you?  
A I know Mr. McDaniel was. I believe we had two  
of them and there were different people on each 09:40AM  
time.  
Q Were there lawyers from Sidley & Austin?  
A I believe there were.  
Q Was Mr. Jorgensen one of those lawyers?  
A Mr. Jorgensen was on at least one of those 09:40AM  
events.  
Q Was Mr. Robert George on one or more of those  
conferences?  
A That I specifically can't remember.  
Q Was there anyone on those conferences 09:40AM  
representing Cargill that you know of?  
A Not that I know of. I probably don't know who  
was representing whom on any of those conference  
calls.  
Q Mr. John Tucker? 09:41AM

282

1	A I don't recognize that name.			Q Did Dr. Dicks ask you to generate numbers or estimates of your own?	
2	Q Mr. Bruce Jones?			A No, sir.	
3	A Don't recognize that name either.			Q So did he then ask you if some estimate he had generated sounded reasonable to you?	09:45AM
4	Q Dr. Coale, did any other experts comment on your report, either on these WebEx conferences or otherwise?	09:42AM		A It was more not the number he generated. It was more he asked my opinion on whether the process or the logic he was using to make the calculations seemed sound, and that's what I basically did.	
5	A Not that I recall. Again, I don't -- I might not even recognize the names of who was on -- I may not have known who was on there, but not that I recall, not that I paid attention to anyway.	09:42AM		Q Which calculations are you talking about?	09:45AM
6	Q Do you recall any other expert being on those calls, anyone you recognized not being a lawyer?			A I believe in my report I mentioned there was certain sections of his expert report that I saw in a draft form, and he asked whether the assumptions they were using, as economists, to make assumptions about soil phosphorus dynamics, whether those were sound assumptions, and I basically read through those two separate sections of his document and read through them and gave him my opinion whether I thought it was sound assumptions or not.	09:45AM
7	A Okay. Again, there were a couple of these WebEx and then there was a couple of conference calls that we had about the document being shared, and what I'm having difficulty doing on the spot here is remembering who was on which of those events. However, I did have a conversation on one of those events. Billy Clay was in a conversation; Mike Dicks was in a conversation, and those are the only two individual names that I believe to be other experts in this case that I can remember.	09:42AM		Q Okay. Just to distinguish, did he ask you to -- what assumptions should I use or did he say this is my assumption, is it reasonable?	09:46AM
8	Q What did Dr. Clay say in whatever conference he was on?			A Oh, he asked me the latter. Asked me, you know, this is how we're going to approach it, does that make sense, and I said seems like that was a	09:46AM
9	A My general recollection was that he was just	09:43AM			
10	283			285	
11	answering questions about characteristics of the IRW that I didn't really understand, you know, what's the average farm look like, what's a typical operation, more on-the-ground descriptive so I could get a mental picture of the farming situations since I had never been there, and that's mainly my -- what I gleaned from his conversation.	09:43AM		pretty good assumption, again, for his purpose, for an economic analysis, which I never saw that.	
12	Q Okay. What about Dr. Dicks; what did he say when he was participating?			Q Yesterday morning Mr. McDaniel gave me a couple of documents, which have been Bates labeled Coale 000281 through 283 -- excuse me, 284. Let me hand that to you and see if you recognize that.	09:46AM
13	A We had a call -- I believe I spoke with him twice, mainly in regard to he was doing an economic assessment and had some questions from me about, from a soil scientist perspective, whether some of the procedures and processes he was going through made sense to me as a soil scientist, and that was the gist of that conversation.	09:44AM		A That appears to be one of the segments of Dr. Dicks' draft report that I reviewed for him.	
14	Q And what was he asking you as a soil scientist?			Q Okay. Did you see any earlier version of that document?	09:47AM
15	A Some basic questions about soil test P and forages and application rates and fertilizer rates and, you know, crop removal rates and those kind of things, and did this sound like a reasonable estimate, does this sound like a reasonable estimate, did you make this assumption, could you make that assumption, just kind of a very general.	09:44AM		A I only saw it one time.	
16	284			Q And it's that one; right?	
17				A As far as I remember, it looked just like this.	
18				Q Okay. Let me show you another document that Mr. McDaniel gave me for the first time yesterday, which has been Bates numbered by him Coale 000285 through 292, and let me see if you recognize that document.	09:47AM
19				A This looks like the second of the two sections from Dr. Dicks' report that I was asked to review.	09:47AM
20				Q Did you ever see any earlier or later version of that?	
21				A No, sir, just the one.	
22				MR. NANCE: Scott, could we make copies in	09:47AM
23					
24					
25					

1 a minute and admit those?

2 MR. McDANIEL: Uh-huh. I may have an extra

3 set here you can go ahead and mark, and then we can

4 make copies for the other counsel if you want to.

5 **Q Dr. Coale, let me hand you first what I've 09:48AM**

6 **marked as Exhibit No. 10, and that's the document**

7 **that has Bates 281 through 284, and ask you if**

8 **that's one of the Clay documents that you looked at**

9 **to form your report.**

10 A I don't know what you mean by Clay document. 09:49AM

11 **Q Excuse me, Dicks document.**

12 A I thought you meant like a soil document.

13 Yeah, this is one of the ones I saw of Dr. Dicks'

14 documents.

15 **Q All right, and is what I marked as Exhibit 11 09:49AM**

16 **the other document that you looked at from Dr. Dicks**

17 **to help fix your report in this case?**

18 A Yes, sir.

19 **Q Are these the documents that you refer to in**

20 **your expert report in Paragraphs 10C and D on Page 09:49AM**

21 **17?**

22 A Yes, sir.

23 **Q Dr. Coale, I prepared some exhibits that are**

24 **from the final report of Rausser and Dicks rather**

25 **than these draft reports. Let me think if there's 09:50AM**

287

1 any way --

2 MR. NANCE: Scott, do you know if those

3 changed materially between the draft and the final?

4 MR. McDANIEL: It's my impression they

5 didn't, but if there was some individual grammatical 09:51AM

6 or -- my impression is there's no substantive

7 change, but I can't sit here and tell you there

8 hasn't been a word changed or something like that.

9 **Q Since I've highlighted mine, I'm going to go**

10 **ahead -- and we may have two very similar sets of 09:51AM**

11 **exhibits here, but I'm going to go ahead and put**

12 **these in, and this one may take a little thinking,**

13 **but this one when I prepared it, I didn't understand**

14 **the situation as well as I do in light of the new**

15 **development. 09:51AM**

16 **Dr. Coale, let me hand you what I've marked as**

17 **Exhibit No. 12. When I was reading your report --**

18 **let me explain. You referred to Section E, and I**

19 **think I have put as the first two pages of Exhibit**

20 **12 a different Section E than you looked at. So let 09:52AM**

21 **me ask --**

22 A It looks different.

23 **Q Yeah. Look at the first two pages of Exhibit**

24 **12 and see if you looked at those pages in**

25 **performing your analysis or preparing your report in 09:52AM**

288

**this case.**

A This doesn't look familiar.

**Q Okay. Would I be safe in concluding that**

**you're not going to offer any testimony at trial on**

**the first two pages of Exhibit 12 or the subject 09:53AM**

**matter therein?**

MR. McDANIEL: All right. Will you hold

off answering your question just a second and give

me a chance to look at this --

MR. NANCE: Certainly. 09:53AM

MR. McDANIEL: -- and then -- let me object

to the form simply because there are embedded

farming concepts within this discussion that you

have touched on with Dr. Coale. If the question is

will he be speaking in terms of this economic 09:54AM

analysis or budgets on a poultry farm that Dr. Dicks

is opining about, I don't object to that question,

but to say he doesn't offer an opinion on anything

discussed in this section, I do object to the form

of that question. 09:54AM

**Q Then let's reask the question. Dr. Coale, do**

**you anticipate offering any testimony on the poultry**

**forage and beef cattle budgets that are discussed in**

**the first two pages of Exhibit 12?**

A No, I don't anticipate doing that. 09:54AM

289

**Q Then let's flip over to the third page, which**

**is Appendix A. You are going to speak about topics**

**that are in there, are you not?**

A Give me a chance to look at it, please.

**Q Please do. 09:55AM**

A Just from a quick comparison, this looks to be

the same or close to the same as the Appendix A

document I reference in my report.

**Q Okay, and in your report in Paragraph 10C on**

**Page 17 you say, I have reviewed Section E and 09:56AM**

**Appendix A; is that right?**

A Correct.

**Q And Exhibit 12 looks like -- I will represent**

**to you is the final report version of Appendix A,**

**which may be a little different than Exhibit 10. 09:56AM**

A Correct.

**Q Okay. As we walk through that part of Exhibit**

**A, which -- excuse me, Exhibit 12, which is Appendix**

**A, if you see something different or that's been**

**changed in your recollection since you did the 09:56AM**

**initial review, would you let me know, please?**

A If I catch it, I will.

**Q Okay. Now, let me ask you first to tell me**

**what the title of Appendix A is.**

A It reads, Appendix A, Current STP Levels Given 09:57AM

290



1 to Historical Litter Production and Parameters  
2 Specified by Literature and Soil Consultants.  
3 **Q Okay. Very broad brush to start out with, Dr.**  
4 **Coale. Were you involved in the front end of**  
5 **designing this particular methodology? 09:57AM**  
6 A No, sir.  
7 **Q Were you rather involved either in the middle**  
8 **or on the back end in offering opinions as to the**  
9 **adequacy or the correctness of the methodology?**  
10 A It was offered to me in this form and with the 09:57AM  
11 understanding that this was -- these were  
12 assumptions and methodology used by Dr. Dicks to  
13 develop an economic assessment, and I've worked with  
14 agricultural economists over the years, and they're  
15 -- they frequent times need to have people with 09:58AM  
16 expertise outside of their economics world to say is  
17 this a fair assessment, is it a fair assumption, is  
18 this a fair approximation, and my role was to read  
19 through this and advise them if they had made any  
20 technical blunders, if they had made fair 09:58AM  
21 assessments, fair assumptions and if their logic was  
22 sound, and that's what my role was.  
23 **Q All right, and as a result of reading through**  
24 **the draft, which I think is Exhibit 10, did you**  
25 **advise Dr. Dicks to make any changes in his work as 09:58AM**  
291

1 **it would appear in the final form?**  
2 A No. I believe my comment to him was his  
3 assumptions looked sound to me.  
4 **Q Okay, and did you tell him that his**  
5 **methodology looked sound to you? 09:58AM**  
6 A Of those words, yes.  
7 **Q Before we launch into this, Dr. Coale, we**  
8 **probably need to change tapes and maybe have a**  
9 **comfort break if that's agreeable.**  
10 A Okay. 09:59AM  
11 VIDEOGRAPHER: We are now off the Record.  
12 The time is 10:00 a.m.  
13 (Following a short recess at 10:00  
14 a.m., proceedings continued on the Record at 10:13  
15 a.m.) 10:11AM  
16 VIDEOGRAPHER: We are back on the Record.  
17 The time is 10:13 a.m.  
18 MR. NANCE: Scott, before we go on, you and  
19 I had a discussion while we were off the Record  
20 about the fact that Rausser and Dicks marked their 10:12AM  
21 report confidential, and let me ask you to confirm  
22 that as far as we're going to be examining Dr. Coale  
23 today, you don't believe there's any confidentiality  
24 issue implicated?  
25 MR. McDANIEL: With regard to the 10:12AM  
292

information that he reviewed and included in his  
report and is prepared to testify about, which is  
that covered in Coale Exhibits 10 and 11, you're  
correct.  
**Q Dr. Coale, I'm looking on Exhibit 12, so let's 10:12AM**  
**make sure we're all on the same literal page, the**  
**Appendix A portion of Exhibit 12. Do you have that**  
**in front of you?**  
A Just a moment. Okay.  
**Q Tell me once again at the 30,000-foot level 10:13AM**  
**what it was that Dr. Dicks was doing in Appendix 12.**  
A The way it was presented to me was that they  
were trying to do an economic analysis of production  
systems in the IRW, and what they needed to do to do  
that analysis was to formulate a scenario they could 10:13AM  
analyze, and they had to make some generalization  
and some approximations and some judgments, and they  
asked whether the ones they made were pertinent to  
my expertise of soil science were -- whether I  
agreed with the methodology we were using to develop 10:13AM  
their approach, and that's basically what I did.  
**Q Okay. So you're not opining that his economic**  
**methodology is sound, are you?**  
A No.  
**Q Do you know if Dr. Dicks called upon any other 10:14AM**  
293

agricultural-related expert -- I guess he mentions  
**Dr. Clay -- besides you and Dr. Clay to help him do**  
**the work in Appendix A?**  
A I don't know.  
**Q Okay, but you're not -- 10:14AM**  
MR. McDANIEL: Can I just raise a point?  
That is -- since that is both Dr. Dicks' and Dr.  
Rausser's report, if -- so I don't want, when we say  
Dr. Dicks, to exclude Dr. Rausser's participation.  
If you want to consider when you say Dr. Dicks, if 10:14AM  
you mean Dicks and Rausser as a team or if you want  
to break them up. I just don't what our Record to  
be a mess and suggest as far as that work product,  
that you can really separate them. All right?  
**Q Dr. Coale, did you ever talk to Dr. Rausser? 10:14AM**  
A Not that I know of.  
**Q Okay. Unless he was one of those people on a**  
**conference call or a WebEx that you can't name?**  
A Correct.  
**Q Did you ever have any E-mail correspondence 10:15AM**  
**with Dr. Rausser or snail mail correspondence for**  
**that matter?**  
A No.  
**Q Okay, and I will acknowledge that Appendix A**  
**is part of a joint report, but if you just talked to 10:15AM**  
294



1 Dicks, that's what I'm going to ask you about.  
2 A Okay.  
3 Q Okay, and what he and Dr. Rausser did  
4 together, I guess, is beyond the scope of our  
5 knowledge in the room right now; right? 10:15AM  
6 A I guess it is.  
7 MR. McDANIEL: Your side of the room.  
8 MR. NANCE: It might proceed more quickly  
9 if we just swear you in and get the whole story.  
10 MR. McDANIEL: We could have -- should have 10:15AM  
11 done that two years ago.  
12 Q All right, and, Dr. Coale, I'll tell you I've  
13 read this a couple of times, and it's one of those  
14 things that I kind of understand, so please bear  
15 with me as we walk through it. I'm just going to 10:15AM  
16 start at the beginning and kind of work our way  
17 towards the end, and the beginning below the title  
18 is a sentence that says, based on data from the  
19 Census of Agriculture and data and assumptions  
20 outlined by plaintiff's consultants, we developed an 10:16AM  
21 estimate of the current average STP for all forage  
22 acres in the IRW. Do you know what Census of  
23 Agriculture data that Dr. Dicks and Dr. Rausser  
24 looked at?  
25 A Specifically, no. 10:16AM

295

1 Q Okay, and we may get to some particulars a  
2 little later on, but other than what might be in  
3 this report, you don't know?  
4 A Correct.  
5 Q Okay, and do you know what particular data and 10:16AM  
6 assumption outlined by plaintiff's consultants that  
7 they looked at?  
8 A No, I don't.  
9 Q Okay. It says, the end result is an average  
10 of STP of 45.5 on all fertilizable forage-producing 10:16AM  
11 acres in the IRW. Is that STP figure one that you  
12 are opining is correct?  
13 A No, sir. I don't know if this will short  
14 circuit what we're trying to do here or not, but I  
15 just evaluated their approach and methodology, and 10:17AM  
16 the numbers they came up with, I don't know where  
17 they got them from.  
18 Q Okay. Let's go through the steps of the  
19 methodology, which I guess are the next things.  
20 A Okay. 10:17AM  
21 Q Step one is estimate the total amount of  
22 phosphorus produced by poultry litter in the IRW  
23 since 1974, which they say the first year data is  
24 available.  
25 A Okay. 10:17AM

296

Q And I guess we'll get into that a little  
later. Is that, in your mind, a valid first step to  
do what they want to do?  
A Makes sense to me, yes.  
Q Step two, estimate the total pounds of 10:17AM  
phosphorus per acre required to raise STP to 65  
based on historical forage yields, parenthesis,  
which remove some amounts of phosphorus, closed  
parenthesis, and a baseline STP level reflective of  
IRW land with no history of poultry litter 10:18AM  
application. Does that seem to you to be a valid  
second step in a methodology?  
A Given that -- I'll say it again. If their  
method -- if their purpose is to make a general  
economic analysis, they have to have these kind of 10:18AM  
assumptions to make that kind of analysis, so, yes.  
Q Okay. Yeah, I'm not asking you to vouch for  
the economics. I'm asking you to vouch for the soil  
science?  
A Okay.  
Q Because that's your area; right?  
A Correct.  
Q Okay. Dr. Coale, do you know if Rausser and  
Dicks assumed that there was no poultry application  
in the watershed before 1974? 10:19AM

297

A I don't know if they made that assumption or  
not.  
Q Okay. Do you know how they handled any land  
application before 1974?  
A I don't recall how they did that. 10:19AM  
Q Okay. Step three, they say calculate the  
average STP rate by comparing the historical pounds  
of phosphorus per acre obtained in step one to the  
amount of phosphorus required to increase the STP to  
65. Does that seem to you to be a reasonable step 10:19AM  
three in this method as a soil scientist?  
A Uh-huh.  
MR. McDANIEL: You said uh-huh.  
A I said yes. Sorry. I'll try to speak up.  
Q Now, the next sentence says, these procedures 10:19AM  
just outlined provide an estimate of an average STP  
for the watershed assuming some things.  
A Correct.  
Q Let's talk about the assumptions. Uniform  
distribution of litter? 10:20AM  
A Yes, sir.  
Q Is poultry litter uniformly distributed  
throughout the Illinois River watershed?  
A I personally don't know, but I doubt that  
that's true. 10:20AM

298

1	<b>Q Why do you doubt that that's true?</b>		would you agree that their assumptions are
2	A Because I would expect it to be utilized in a		uncharacteristic of the real world in the Illinois
3	very -- very variably across the watershed.		River watershed?
4	<b>Q The second assumption is uniformity of soils.</b>		A I believe they grossly over generalize what
5	<b>Does that strike you, as a soil scientist, as a</b> 10:20AM		the watershed probably looks like. 10:23AM
6	<b>reasonable assumption about the Illinois River</b>		<b>Q They say that their purpose of the economic</b>
7	<b>watershed?</b>		<b>analysis is determining a median or weighted average</b>
8	A No.		<b>STP for the fertilizable forage-producing areas of</b>
9	<b>Q Okay. Why not?</b>		<b>the watershed. How did they provide a median or</b>
10	A I wouldn't expect the soils to be uniform 10:21AM		<b>weighted average STP?</b> 10:24AM
11	across the watershed.		A I don't recall the process they went through.
12	<b>Q Okay. Their next assumption is -- just says</b>		I may not have even read the process they went
13	<b>land types. Do you believe they're assuming that</b>		through.
14	<b>the land types of the watershed are uniform?</b>		<b>Q Okay. Maybe we'll find it out as we go along.</b>
15	A I don't exactly know what the word land type 10:21AM		<b>Then they say, we categorically assert that we have</b> 10:24AM
16	means.		<b>no actual data and believe that none currently</b>
17	<b>Q Okay, and that being the case, are their</b>		<b>exists to enable a true calculation of an accurate</b>
18	<b>assumption about land types reasonable?</b>		<b>value of the central tendency of STP in the</b>
19	MR. McDANIEL: I want to be object to the		<b>watershed.</b>
20	form. Reasonable doesn't have a context. 10:21AM		A Okay. 10:24AM
21	<b>Q In the context of soil science?</b>		<b>Q I guess you're not going to dispute that they</b>
22	A From a very generic interpretation of what		<b>don't have any actual data?</b>
23	land type might mean, I interpret it to mean slope,		A No, I'm not.
24	flat land versus hilly land, versus steep sloped		<b>Q So we'll assume they have no actual data, and</b>
25	land. Those would be -- my presumption is that's 10:22AM		<b>we'll assume that they believe that no such data</b> 10:24AM
	299		301
1	what was meant by land type, which I expect to be		exists. Are you aware of the existence of any data
2	variable across the watershed.		that would enable the true calculation of an
3	<b>Q Did you discuss slope and all that with Dr.</b>		accurate value of central tendency of STP in the
4	<b>Rausser and Dr. Dicks?</b>		watershed?
5	A No. 10:22AM		A No, I'm not. 10:25AM
6	<b>Q Okay. Livestock and agronomic practices. Did</b>		<b>Q Okay, and help me out. As a non-statistician,</b>
7	<b>you tell them anything about livestock and agronomic</b>		<b>what does central tendency of STP mean?</b>
8	<b>practices in the IRW?</b>		A It means to calculate a statistic that
9	A No, I did not.		describes the average value, and that can be
10	<b>Q Okay. Would you agree with them that their</b> 10:22AM		weighted to land area or weighted to whatever factor 10:25AM
11	<b>assumptions are certainly uncharacteristic of the</b>		you want it to be weighted by. It means where's the
12	<b>watershed?</b>		average over the range you're looking at.
13	A My understanding was that -- and I've run		<b>Q Next they say, lacking that true and accurate</b>
14	across this over the years working with economists.		<b>value, we have used the data available to derive a</b>
15	They have to make very broad generalizations to make 10:23AM		<b>mathematical approximation of this measure using the</b> 10:25AM
16	everything uniform to apply economic decisions. So		<b>following steps and assumptions?</b>
17	when I'm in a discussion with an agricultural		A Uh-huh.
18	economist and they say we have to assume this, this,		<b>Q Is it valid scientifically as a soil scientist</b>
19	this and this, you dismiss it as a -- you have to		<b>to proceed without a true and accurate value the way</b>
20	make everything -- you have to make the world flat 10:23AM		<b>they did?</b> 10:26AM
21	before you can apply the numbers to it, and that's		A I would not.
22	the starting point. So I wasn't surprised that this		<b>Q All right. The next -- the next major part of</b>
23	is where the discussion started because I've seen it		<b>the report is headed, step one, calculate total</b>
24	before, but I realized it's not real world.		<b>litter produced historically; right?</b>
25	<b>Q Okay, and as a real world soil scientist,</b> 10:23AM		A Correct. 10:26AM
	300		302

1 Q They say, determining the amount of phosphorus  
2 produced in the IRW requires an estimate of the  
3 historical tons of litter produced in the IRW. Do  
4 you have any agreement or disagreement with that  
5 sentence? 10:26AM  
6 A No. It makes sense.  
7 Q Okay. The census and USDA's National  
8 Agricultural Statistics Service have data on the  
9 number of chickens produced in Oklahoma, and then  
10 they say Adair, Cherokee, Delaware, annually from 10:26AM  
11 1974 to 1985. Beginning in 1992 it is available on  
12 a five-year basis, 1992, 1997, 2002. Now, tell me  
13 what the USDA National Agricultural Statistics  
14 Service is.  
15 A It's a branch of the USDA that for every 10:27AM  
16 county in the country, they try to track  
17 agricultural products, whether it be corn or  
18 chickens or cows or milk or what it might be, and  
19 they tried to do surveys to determine how much is  
20 produced or generated in each county in the country. 10:27AM  
21 Q Speaking of chickens and turkeys, how do they  
22 do those surveys?  
23 A I don't know how they do the surveys.  
24 Q Are you here as a soil scientist or an  
25 environmental scientist prepared to vouch for the 10:27AM  
303

1 accuracy of the USDA surveys?  
2 A No.  
3 Q Okay. Data on the -- next sentence is, data  
4 on the number of birds in Arkansas counties, Benton  
5 and Washington, is available for 1997 and 2002 only. 10:28AM  
6 Let me ask you, Dr. Coale, did you go to the books  
7 and pull out the census or online or wherever you go  
8 and pull out the Census of Agricultural Statistics  
9 and verify any of the numbers that Rausser and Dicks  
10 used to make Appendix A? 10:28AM  
11 A No, sir. Like I said before, I didn't verify  
12 any of these numbers.  
13 Q Okay. Now, there's another county that -- in  
14 Oklahoma that has part of it in the watershed, and  
15 that is Sequoyah County. Do you see anywhere in 10:28AM  
16 here where they have assembled bird numbers for  
17 Sequoyah County or any part of it?  
18 A I don't see it mentioned.  
19 Q Okay. If you were going to do this job and do  
20 it accurately, would you need to make some allowance 10:29AM  
21 for whatever is going on in Sequoyah County that's  
22 pertinent?  
23 MR. McDANIEL: Object to the form.  
24 A I don't know if the poultry production in  
25 Sequoyah County is pertinent, but if it was, it 10:29AM  
304

would have to be included.  
Q Okay. Dr. Coale, do you know how Rausser and  
Dicks accounted for poultry production in Arkansas  
before 1997?  
A No. 10:29AM  
Q Okay. Would you agree with the suggestion  
that they have been producing a lot of chickens in  
Arkansas well before 1997, at least in the  
watershed?  
A I believe the industry has been established 10:30AM  
before 1997.  
Q Okay. In the Arkansas part of the watershed?  
A That's my general understanding, yes.  
Q Right. In addition, we have an estimate for  
the amount of litter produced in the most current 10:30AM  
year. Plaintiff's consultant estimates this to be  
354,000, revised from 347,000, and defendants'  
expert estimates this to be approximately 295,114  
tons or a net 225,114 for litter exportation  
beginning in 2004 is included. Do you have any 10:30AM  
independent knowledge or opinion on the correctness  
of any of the numbers in that sentence?  
A No, sir.  
Q Have you looked at any of the expert reports  
for either plaintiff or defendant from which those 10:30AM  
305

numbers are taken?  
A I don't know where they come from.  
Q Next paragraph, once an estimate of poultry  
litter production for land application is developed,  
the pounds of phosphorus is simply the tons of 10:31AM  
litter multiplied by 60, given that there are  
approximately 60 pounds of phosphorus to one ton of  
litter. I think we're back in your area here.  
A Yeah.  
Q Is that a reasonable assumption that there are 10:31AM  
60 pounds of phosphorus per ton of litter?  
A Of course, there's going to be a lot of  
variability in how much phosphorus per ton there is,  
and if you are going to manage it specifically, you  
really should understand how much -- what the 10:31AM  
phosphorus content is of that lot of litter that you  
are managing. 60 is a typically used average  
number.  
Q Okay.  
A So if they're using that for an average 10:31AM  
approximation, it's a reasonable number.  
Q Okay. Is it an average number that would  
apply to turkey litter as well as poultry litter?  
A I can't say.  
Q Then they say, to estimate the total litter 10:32AM  
306

1 produced between 1974 and 2007 required several  
 2 extrapolations. These include, and they got, A, the  
 3 number of birds for years with missing data. I  
 4 guess if you only have data for certain years,  
 5 you've got to fill in the blanks, right; is that 10:32AM  
 6 what they're saying?  
 7 A I believe so.  
 8 Q Is that a scientifically valid way from your  
 9 point of view to do the job at hand?  
 10 MR. McDANIEL: Object to the form. 10:32AM  
 11 A If it was essential in their analysis to have  
 12 a value for every year, I would probably look at the  
 13 year before and the year after, and say it's  
 14 midpoint between those two points.  
 15 Q Okay. Dr. Rausser and Dicks are retained 10:33AM  
 16 experts for the defendants in this case, are they  
 17 not?  
 18 A I understand that to be correct.  
 19 Q Do you think the defendants in this case know  
 20 how many birds they've produced? 10:33AM  
 21 MR. McDANIEL: Object to the form.  
 22 A I have no idea.  
 23 Q If you were wanting to know how many birds had  
 24 been produced historically in the watershed by the  
 25 people who hired you, would you go to the people who 10:33AM  
 307

1 hired you and ask them?  
 2 A And I haven't been asked to do this, but I  
 3 would probably look for public records of production  
 4 estimation, like the National Eco Statistics Service  
 5 people, a place to start. If I wasn't satisfied 10:33AM  
 6 with that data because it was incomplete, I would  
 7 try to find direct data from the industry if I  
 8 could.  
 9 Q Do you have any indication that they have gone  
 10 to their own clients to try to find the data to fill 10:34AM  
 11 in the blanks?  
 12 A I don't know where they got that data from.  
 13 Q Okay. Just as an affirmative matter, do you  
 14 have any indication they went to their own clients?  
 15 A I have no indication. 10:34AM  
 16 Q Okay. Would going to their own clients to get  
 17 the numbers be a more reliable method than  
 18 interpolating to fill in the blanks?  
 19 A I guess I'm hesitating because I don't know  
 20 what level of precision they needed for the purposes 10:34AM  
 21 of their economic model. It may have been good  
 22 enough to interpolate. They may not have to worry  
 23 about it, or it may have been the case they needed  
 24 the best data they could get their hands on. I  
 25 don't know. 10:34AM  
 308

Q Since the end point of the analysis appears to  
 be trying to do an average of STP, how precise do  
 you think you need to be?  
 A I think you need to be -- to get an average  
 STP value that is really truly physically 10:35AM  
 representative, I think you need to be very precise.  
 Q Okay. B, it says the next thing that they  
 have to extrapolate is the relationship between  
 poultry production in the three Oklahoma counties  
 and the two Arkansas counties. Now, putting aside 10:35AM  
 the fact that Sequoyah County is not represented,  
 let's --  
 A Okay.  
 Q Why is it that you need to know the  
 relationship between poultry production in the 10:35AM  
 Oklahoma counties versus the Arkansas counties?  
 A I really don't know what that sentence means.  
 Q That's at least two of us in the room. Okay.  
 C at the top of Page 2 of Appendix A, the other  
 extrapolation they say they need to do is the 10:35AM  
 relationship between the number of birds in  
 inventory in the five-county area and the amount of  
 litter produced in the IRW. What does that sentence  
 mean?  
 A Well, from my interpretation, they need to 10:36AM  
 309

know -- they would need to determine the ratio of  
 number of birds to tons of litter.  
 Q Okay. All right. Then I guess we're going to  
 show the next three paragraphs appear to be those  
 three extrapolations and how they did them. 10:36AM  
 A Okay.  
 Q A in bold print, it says estimating the number  
 of birds for the years for which there is missing  
 data, and they say in all cases where there was  
 missing data for a particular year, e.g., between 10:36AM  
 1987 and 1992, we used linear interpolation to  
 create missing data points. Using this method, we  
 have annual data on the number of bird, chickens, in  
 the three Oklahoma counties. Tell me what linear  
 interpolation is. 10:37AM  
 A Just what I referred to before. If you have a  
 missing year in this case, you would use the data  
 that you have, plot it out year versus whatever the  
 measure is here is number of chickens, and draw a  
 linear relationship with a constant slope through 10:37AM  
 it, and then whatever the value of that linear  
 relationship for the year that's missing, you would  
 choose that to be your missing data point.  
 Q Is it scientifically valid to create missing  
 data that way? 10:37AM  
 310

1 MR. McDANIEL: Object to the form.  
 2 A It's been done and in some cases depends on --  
 3 in some cases it's a fine estimation and in some  
 4 cases it's a too gross of an estimation. Depends on  
 5 the goal and how it's going to be used. 10:38AM

6 Q But to figure out an STP that mirrors the  
 7 physical world, you'd need as much precision as you  
 8 can get?

9 MR. McDANIEL: Object to the form.  
 10 A That's correct. 10:38AM

11 Q Okay. So for the Oklahoma counties, it looks  
 12 like they have data, and check me if I'm wrong, they  
 13 have data that goes back from the USDA from '74 to  
 14 '85, and then are they linearly interpolating to  
 15 fill in the blanks from '87 to '92; is that what 10:38AM  
 16 they're saying they've done for the Oklahoma  
 17 counties?

18 A That's my interpretation, yes.

19 Q Okay. Have you seen their work, I mean the  
 20 actual graphs or the computations or anything like 10:39AM  
 21 that?

22 A No. This is the full extent of what I have  
 23 seen.

24 Q All right, sir. The next heading is B,  
 25 estimating the total number of birds in the 10:39AM  
 311

1 five-county area. In 2002 there was a total  
 2 inventory of 49,350,782 chickens in the five-county  
 3 area. Do you know where that number came from?

4 A No, I don't.

5 Q Consequently, I assume you don't know whether 10:39AM  
 6 it's valid or not?

7 A Correct.

8 Q Then they have a parenthesis, a parenthetical  
 9 that says there is 51,984,263 including turkeys, and  
 10 it drops a footnote. Do you know where the 10:39AM  
 11 fifty-one million nine hundred some odd including  
 12 turkeys comes from?

13 A No, sir.

14 Q Now, their footnote says, we have no  
 15 information on when the turkeys arrived or how many 10:40AM  
 16 turkeys were there since the census data for the  
 17 early years, 1974 to '85, is only available for the  
 18 number of chickens. As such, we estimate the  
 19 relationship between chicken production, broilers  
 20 and layers in the Oklahoma counties and the Arkansas 10:40AM  
 21 counties and exclude turkeys. Do you know what that  
 22 means?

23 A I would say they decided not to include  
 24 turkeys.

25 Q So the turkeys just get written out of the 10:40AM  
 312

equation?

A That's my interpretation.

Q Okay. Okay. Now, they go on to say back to  
 the main part of the text, of those, approximately  
 8.8 million, or 17.88 percent, were located in 10:41AM  
 Oklahoma counties. Do you know where they got that?

A No, sir.

Q All right, and I'm assuming or am I correct in  
 assuming that up to this point under Subheading B,  
 we're talking about 2002 because that's what the 10:41AM  
 previous sentence --

A I would agree.

Q Okay. The next sentence begins, in 1997 there  
 were approximately 48,760,637 birds in the  
 five-county area, of which approximately 7.6 10:41AM  
 million, or 15.57 percent, were located in Oklahoma.  
 Do you know where any of those numbers came from?

A No, I don't.

Q This means that between 1997 -- I'm reading  
 the next sentence -- and 2002, the share of the 10:42AM  
 total birds in the five-county area in Arkansas  
 increased by approximately 2.31 percent or .46  
 percent annually. Can you explain to me what that  
 means?

A From their numbers, and I haven't done the 10:42AM  
 313

math, presumably they are looking at the rate of  
 increase in the population of birds in that area.

Q In the Arkansas part of the area?

A In the Arkansas, yes, correct.

Q So is this one of those linear interpolations 10:42AM  
 where they're trying to account for the growth in  
 Arkansas between '97 and 2002?

A It may be. I -- I don't really follow it real  
 clearly.

Q In order to estimate the total number of birds 10:43AM  
 in the five-county area for the missing years of  
 data, we assumed that this relationship held  
 constant over the entire time period. Do you know  
 what the entire time period is?

A Offhand, I don't. 10:43AM

Q Okay. Is this something you ever discussed  
 with either Dr. Rausser or Dicks?

A No, sir. Never at any of this level of  
 detail.

Q All right. If the time period began in 1974 10:43AM  
 because they say that's as far back as they have any  
 data --

A Uh-huh.

Q -- are they -- I'm going to try to get this  
 right -- taking the 1997, their 1997 estimate of 10:44AM

314

1	Arkansas birds and reducing it .46 percent every		estimate of 354,000 tons of litter. So what does	
2	year backwards to 1974?		that mean?	
3	A That looks like a way it could be applied. I		A They had -- if you go back up in the second	
4	don't know if that's what they did or not. I have		sentence under C, they had two estimates above the	
5	no knowledge of that. 10:44AM		amount of tonnage of litter in their -- in the 10:48AM	
6	Q Okay. Would that be a valid way to create the		watershed. One is 354,000; the other was 221,114	
7	data to fill in the graph?		(sic). So I think the footnote refers to if they	
8	A It's a legitimate approach.		made the calculation using the 354,000 tons instead	
9	Q Is that the way you teach your students at		of the 225,114 tons.	
10	University of Maryland to do things? 10:44AM		Q All right. Let's stop a moment and let my 10:48AM	
11	A No, we don't teach it this way.		brain try to catch up. .0058 tons would be how much	
12	Q Okay. We used the current ratio of number of		in pounds approximately?	
13	birds produced in the IRW obtained from Billy Clay		A I'll need a calculator for that.	
14	to the inventory of birds from census in the		MR. NANCE: Do you have one of yours?	
15	five-county area as a constant factor in determining 10:45AM		MR. McDANIEL: Do you seriously think I 10:48AM	
16	the number of birds produced to annual inventory		brought a calculator in here?	
17	numbers throughout the time period. What does that		MR. NANCE: I brought a calculator with a	
18	sentence mean?		rubber band around it.	
19	A Apparently had obtained a ratio, number of		Q There you go.	
20	birds produced to the -- from one source versus what 10:45AM		A Would you say the question again, please? 10:49AM	
21	the census said, being another source, and then they		Q What does 0.0058 tons work out to be in	
22	used that to create the -- use that ratio to fill in		pounds?	
23	the annual inventory numbers for when they didn't		A 11.6.	
24	have them.		Q Does 11.6 pounds of litter per bird sound	
25	Q Okay. Do you know what it was that Dr. Clay 10:45AM		reasonable to a man in your profession? 10:49AM	
	315		317	
1	gave them to do that?		A I rarely look at generation on a per-bird	
2	A No, I don't.		basis. I don't have a basis for answering that.	
3	Q All right. Subheading C, estimating the total		Q Would the answer be the same if we looked at	
4	amount of litter produced. We have several		the figure in Footnote 2 of 0.0069 tons per bird?	
5	estimates of the annual amount of litter available 10:46AM		A Whether I thought the outcome is reasonable? 10:50AM	
6	for land application in the IRW in recent years.		Q Yeah.	
7	These estimates include 354,000 tons from		A Yeah, same answer.	
8	plaintiff's consultant, Dr. Fisher, and 225,114 tons		Q Okay. Their next sentence in the text under	
9	from defendants' consultant, Dr. Clay. The		Subparagraph C, assuming that 225,114 tons of litter	
10	relationship between the litter produced and the 10:46AM		are land applied after the exportation program 10:50AM	
11	census inventory of birds is approximately 0.0058 in		became effective in 2004 and 295,114 was land	
12	2007, given an estimated land applied litter of		applied in the prior year, the total tons of litter	
13	295,114 tons, and they drop another footnote. Do		produced between 1974 and 2007 is approximately	
14	you know how they did that?		8,017,422, I assume tons but they don't say it.	
15	A No, I don't. 10:46AM		Have you done the math on that? 10:51AM	
16	Q Okay. Do you know what the 0.0058 number		A No, I have not.	
17	represents?		Q Do you understand how they did the math on it?	
18	A From this sentence, I interpret that to be		A No. I'd have to study it in much detail to	
19	litter produced per bird.		figure out what they did.	
20	Q Okay. In what units; can you tell? 10:47AM		Q Dr. Coale, I admit I was listening to my 10:51AM	
21	A I can't tell for sure, but the only units in		counsel or my colleague and not to you, so will you	
22	that sentence is in tons.		repeat your answer?	
23	Q Okay. Let's take the footnote down to --		A The answer is, no, I don't know how they did	
24	Footnote No. 2 down to the bottom. That footnote		it.	
25	reads, the litter to bird ratio is 0.0069, using an 10:47AM		Q Do you know what the import program is in the 10:51AM	
	316		318	



1 Illinois River watershed, or excuse me, export  
2 program?  
3 A No, I don't.  
4 Q Do you know if any litter is imported into the  
5 Illinois River watershed? 10:52AM  
6 A I don't know that.  
7 Q Okay. Their next sentence is, if we assume  
8 that 354,000 tons of litter is land applied, the  
9 total amount of litter is 9,659,093 tons for the  
10 same time period, and then it drops a Footnote 3. 10:52AM  
11 Once again, and I realize that's using the  
12 plaintiff's expert number, but do you know how they  
13 used that number to come up with a calculation that  
14 gets you 9.6 million tons?  
15 A I've not checked that calculation. I don't 10:52AM  
16 know how they did it.  
17 Q All right, and, consequently, you're not in a  
18 position to vouch for it, are you?  
19 A No, I'm not.  
20 Q Okay. The Footnote 3 says, if we assume that 10:52AM  
21 poultry litter production has been 354,000 tons  
22 since 2002 and has remained constant, then the total  
23 litter produced would be 10,139,750 tons and,  
24 semicolon, for annual production of 295,114, there  
25 would be a total of 8,453,057 tons. Do you know why 10:53AM  
319

1 they're assuming constant production since 2002?  
2 A No, I don't.  
3 Q Okay, and consequently -- well, never mind.  
4 The next step in their analysis, step two, estimate  
5 the total pounds of phosphorus per acre required to 10:54AM  
6 raise STP to 65. Our general assumption is there's  
7 one source supplying phosphorus on an annual basis,  
8 poultry litter, and two factors that demand  
9 phosphorus, soil to get the STP up to 65 and reach  
10 100 percent yield, and actual forage, pasture and 10:54AM  
11 hay produced. Are they assuming or accounting for  
12 any other source of phosphorus in the watershed  
13 besides poultry litter?  
14 A No. They state right out that they're only  
15 considering litter. 10:55AM  
16 Q Do you know -- for each ton of forage  
17 produced, 13.7 pounds of phosphorus are removed. Is  
18 that a realistic figure?  
19 A Hang on one second. I'll do a little math.  
20 It's reasonable, yeah. 10:56AM  
21 Q Explain to me the calculation you just did.  
22 A Oh, I just did it on a percentage basis of a  
23 percent of a ton, if 1 percent of a ton of forage is  
24 13.7 pounds.  
25 Q Dr. Coale, is it a reasonable assumption that 10:56AM  
320

poultry litter is the only source of phosphorus in  
the Illinois River watershed?  
A In the real world, probably not, but perhaps  
it's good enough for their purposes.  
Q Over on the top of Page 3, hay output from 10:56AM  
1974 to 2007 was determined using methods similar to  
those for estimating litter production. Hay output  
data was collected for Adair, Cherokee and Delaware  
Counties for 1974 through 2007 and Benton and  
Washington Counties for 1997 through 2002. Do you 10:57AM  
know where they collected that data?  
A No. My assumption would be from the National  
Agricultural Statistics Service, but it doesn't say.  
Q But it doesn't say that, okay. Using this  
data, we estimate that hay -- that total hay 10:57AM  
production for the period -- time period was roughly  
11.8 million tons. Do you have any firsthand  
knowledge of how they did that calculation?  
A Other than the opening sentence saying they  
used methods similar to what they did for the litter 10:57AM  
production estimates.  
Q So they created the data points between where  
they had data and where they didn't have data?  
A I would assume that's what it means.  
Q Okay, but do you know with more certainty than 10:58AM  
321

an assumption?  
A No.  
Q Okay. Given this level of hay production,  
81,086 tons of phosphorus is required over that 10:58AM  
period. Is that a reasonable estimate of the amount  
of phosphorus needed to produce 11.8 million tons of  
something, hay?  
A Again, I haven't checked the math.  
Q Okay. Because the common practice in the IRW  
is to remove hay from the fields of production to 10:58AM  
storage areas in close proximity to winter feeding  
lots or to move it directly from the fields to the  
lots at the time of feeding, we assumed that all the  
phosphorus is removed from the hay fields and  
transported to the, quote, all other areas (sic), 10:58AM  
closed quote.  
A Acres, all other acres.  
Q Acres, excuse me. They don't cite a source  
for that assumption. Do you know why they assumed  
that it's a common practice in the Illinois River 10:59AM  
watershed to do that?  
A I presume their knowledge of the watershed led  
them to believe it was the common practice.  
Q Where does Dr. Rausser live?  
A I have no idea. 10:59AM  
322

1 **Q Do you think he lives in Oklahoma?**  
2 A I -- I don't know.  
3 **Q Okay. Do you have any basis for thinking**  
4 **either one of these two economists knows the**  
5 **agricultural practices in this watershed? 10:59AM**  
6 MR. McDANIEL: Object to the form.  
7 A No, but I believe earlier on they said they  
8 were in consultation with Billy Clay, who seems to  
9 have personal knowledge of what is going on in the  
10 watershed. 10:59AM  
11 **Q Okay. Do you know if Dr. Clay has done any**  
12 **scientifically valid study of the use of hay in the**  
13 **Illinois River watershed?**  
14 MR. McDANIEL: Object to the form.  
15 A I don't know that. 11:00AM  
16 **Q Okay. Would anecdotal information from Dr.**  
17 **Clay or anyone else be a valid basis for an**  
18 **assumption like this?**  
19 MR. McDANIEL: Object to the form.  
20 A I don't know. 11:00AM  
21 **Q You're certainly not in a position, are you,**  
22 **to endorse an anecdotal report from Dr. Clay or**  
23 **anybody else to --**  
24 A No, sir.  
25 **Q Okay. Pasture forage output was estimated 11:00AM**  
323

1 **using the average hay yields for the period and the**  
2 **total fertilizable pasture acres for the area. What**  
3 **does that mean?**  
4 A That means that total -- interpreting that  
5 sentence says that total forage production was 11:00AM  
6 estimated using the average hay yields on, I would  
7 presume, a per-acre basis and over the total acreage  
8 available. So you get average yield per acre.  
9 **Q However, because the pasture forage is removed**  
10 **directly by cattle in the fields, only a portion of 11:01AM**  
11 **the phosphorus is actually removed from the field.**  
12 **Roughly 10 percent of the phosphorus is removed in**  
13 **the development of beef cattle. Does that mean 10**  
14 **percent of the phosphorus in the forage; is that how**  
15 **you interpret that? 11:01AM**  
16 A They said there approximately 10 percent of  
17 the phosphorus in the forage stays in the animal.  
18 **Q Okay. Is that a reasonable number?**  
19 A It's reasonable.  
20 **Q Okay. However, according to Clay, 11:01AM**  
21 **approximately 40 percent of the phosphorus is**  
22 **transported by cattle through their defecation in**  
23 **wooded and riparian areas, including the streams and**  
24 **other water-holding bodies. Are you aware of**  
25 **whether or not Dr. Clay has performed any survey or 11:02AM**  
324

**made any empirical observations that support such a**  
**proposition?**  
A I don't know.  
**Q Do you know where Dr. Clay came up with that**  
**40 percent figure? 11:02AM**  
A I do not know.  
**Q Then are you in a position to validate it as**  
**in any way scientifically correct?**  
A I don't know where it came from, no, sir.  
**Q Would a stream through a field be a means of 11:02AM**  
**active transport for phosphorus?**  
A Yes.  
**Q Would it be a means of active transport for**  
**phosphorus in poultry litter if litter were applied**  
**near that stream? 11:02AM**  
MR. McDANIEL: Object to the form.  
A If litter was in the stream?  
**Q Applied near the stream.**  
A And it was transported from where it was  
applied to the stream, then the stream would act as 11:03AM  
a transport pathway.  
**Q Okay. The next sentence, another source of**  
**phosphorus is comes from fields where forage has**  
**been, parenthesis, fescue, closed parenthesis,**  
**stockpiled, parenthesis, growth saved for later use, 11:03AM**  
325

**closed parenthesis, or overseeded and limit grazed.**  
**Do you know what that means?**  
A I have a general sense what it means but not  
precisely.  
**Q Give me your best general sense. 11:03AM**  
A Well, stockpiled refers to when you grow a lot  
of forage on a field and then you don't harvest it  
for hay and don't let the cow graze it; you leave it  
there for utilization at a later time.  
**Q All right. There's a Footnote 4 where they 11:03AM**  
**make certain assertions about what goes on in the**  
**watershed. Do you know the basis for the assertions**  
**in Footnote 4?**  
A I have to read Footnote 4.  
**Q Please do. 11:04AM**  
A They describe what is meant by that practice,  
but I don't know where they got that information  
from.  
**Q Okay. Dr. Coale, does storage of forage in an**  
**area increase the STP in that area, of the soil in 11:04AM**  
**that area?**  
A Stockpiled storage?  
**Q Right.**  
A No, sir, I wouldn't expect it to.  
**Q If it was just left there, would it increase 11:04AM**  
326

1	the STP?			prior to any poultry litter STP was approximately	
2	A I wouldn't expect it to.			20, and there's a footnote. Does an STP of 20	
3	Q Okay. Next sentence, this practice allows			strike you as a reasonable average for the Illinois	
4	cattle to graze in the forage areas during short			River watershed before any fertilizer was applied?	
5	periods and then return to winter feed areas. Next	11:05AM		A Well, first I would need to know units,	11:08AM
6	sentence, thus, while only 10 percent of the			whether they are talking pounds per acre or parts	
7	phosphorus actually leaves the watershed through the			per million.	
8	sale of cattle, more phosphorus is transported off			Q That's an important thing to know.	
9	the fertilizable fields onto wooded, riparian,			A Yeah.	
10	winter feeding and other acres during the normal	11:05AM		Q Although they appear to be talking pounds per	11:08AM
11	cattle grazing and management. Is the correctness			acre throughout.	
12	of that statement dependent upon the assumptions			A From the footnote that is on that sentence,	
13	that go into it?			the Footnote 8, that footnote has it in milligrams	
14	A Yes.			per kilogram.	
15	Q Okay, and we estimate that, based on the	11:05AM		Q So it's confusing, is it not?	11:08AM
16	assumptions, the total amount of phosphorus removed			A Yes.	
17	from the fertilizable pasturelands over the period			Q Okay. If it was 20 pounds per acre, would you	
18	at 129,633 tons. Do you know how they arrived at			consider it a reasonable average for the whole	
19	that number?			watershed before any fertilizer was applied?	
20	MR. McDANIEL: Just for the Record, you	11:06AM		A I don't think I can really speculate that.	11:09AM
21	misread the tonnage at the end.			Q Same question. If it were in milligrams per	
22	Q I'm sorry. The correct number, if I misspoke,			kilogram or 20 milligrams per kilogram, would it be	
23	was 129,663 tons.			a reasonable estimate of the STP of the whole	
24	A No, I don't.			watershed before any fertilizer was applied?	
25	Q Next paragraph, Oklahoma State University uses	11:06AM		A I have no way of answering that either.	11:09AM
	327			329	
1	an STP of 65 as the level of phosphorus in pounds			Q Top of Page 4, thus, STP would need to be	
2	per acre that is required for 100 percent yield			raised approximately 45 units, 65 minus 20, to	
3	sufficiency, while an STP of 120 ensures that all			achieve the minimum requirement for 100 percent	
4	areas of the field reach the average STP of 65. I			field efficiency. Well, that may answer the	
5	think we understand that.	11:06AM		question.	11:09AM
6	To obtain a reasonable estimate of STPs prior			A That may answer the question. It gives the	
7	to any poultry litter application, we relied on soil			context.	
8	samples taken by plaintiff consultant, Dr. Olsen.			Q All right. A conservative estimate, given	
9	Drops a Footnote 6. Although we're aware that the			OSU's determination that STP of 120 to ensure all	
10	court has deemed Dr. Olsen's analysis not	11:06AM		points in the field have an STP of 65. Then it	11:09AM
11	sufficiently reliable, we required a baseline			says, approximately 12 pounds of phosphorus are	
12	estimate of STP in the IRW, and these were the only			required to raise STP by one unit. Is that a	
13	such samples available for us at the time of filing			reasonable estimate?	
14	this report. Do you personally know what the court			A That's the number that -- I think Dr.	
15	has said one way or another about the reliability of	11:07AM		Johnson's report said between 10 to 15. So that's	11:10AM
16	Dr. Olsen's baseline STP?			the midpoint of that range.	
17	A No, I don't.			Q So for that purposes, it would be a reasonable	
18	Q Okay. Dr. Olsen appears to have taken samples			number?	
19	of three fields that had not received commercial			A Probably, yeah.	
20	litter fertilizer -- commercial fertilizer	11:07AM		Q Okay. For the 491,276 acres of fertilizable	11:10AM
21	applications over seven years and never received			forage production in the IRW, this would amount to	
22	poultry litter; however, one sampled field may have			132,645 tons of phosphorus fertilizer required to	
23	received a poultry litter application of 10 to 15			raise STP from 20 to 65. First, do you know where	
24	years ago. Drops a footnote. Based on Olsen's			they came up with the 491,000 acres number?	
25	referenced soil sample, we assume that the baseline	11:07AM		A No, but did they present that earlier?	11:10AM
	328			330	

1	<b>Q</b> I think we've seen that same number before.		<b>Q</b> Step three, calculate the STP rate. In steps	
2	A I think I recognize the number, but I didn't		one and two, we established the total tons of litter	
3	know how they generated it then, so I don't know		produced from 1974 to 2007 and the total tons of	
4	now.		litter required to increase STP to 65 on a per-acre	
5	<b>Q</b> Okay. Have you done the calculation that they 11:10AM		basis. There have been approximately 8 million tons 11:21AM	
6	say you would need 132,645 tons to raise it from 20		of litter produced for land application since 1974	
7	to 65?		and 16.9 million tons of litter produced based on	
8	A No, I have not.		491,276 forage acres in the IRW.	
9	<b>Q</b> Okay. So you're not at this point prepared to		MR. McDANIEL: Bob, I think you misread	
10	vouch for it? 11:11AM		that. 11:21AM	
11	A No. I haven't done the math.		MR. NANCE: I may have.	
12	<b>Q</b> Okay.		MR. McDANIEL: Starting with 16.9. I think	
13	MR. NANCE: Let's change tapes and try to		you inserted the word million.	
14	keep moving ahead.		<b>Q</b> 16.9 tons of litter per acre based on 491,276	
15	VIDEOGRAPHER: We're now off the Record. 11:11AM		forage acres. 11:21AM	
16	The time is 11:12 a.m.		MR. McDANIEL: Not an insubstantial issue.	
17	(Following a short recess at 11:12		MR. NANCE: It's six powers of ten.	
18	a.m., proceedings continued on the Record at 11:20		<b>Q</b> Can you vouch for those computations?	
19	a.m.)		A No, I can't.	
20	VIDEOGRAPHER: We are back on the Record. 11:18AM		<b>Q</b> In step two above, we established that 23 tons 11:21AM	
21	The time is 11:20 a.m.		of litter per acre are required to reach an STP of	
22	<b>Q</b> Dr. Coale, the next paragraph on Page 4 of		65 on each acre, 34 tons to ensure STP of 65	
23	Appendix A says, thus, the total phosphorus required		uniformly across all acres. Since there is only an	
24	to produce all forage and obtain an STP of 65 is		average of 16.9 tons of poultry litter per acre,	
25	estimated to be 343,394 tons over the period 1974 to 11:19AM		only 70 percent of the litter required to reach an 11:22AM	
	331		333	
1	2008. That's -- do you know how they arrived at		STP of 65 has been land applied. 48 percent to	
2	that number?		ensure an STP uniformly across all acres. What does	
3	A No, I don't.		that sentence mean, sir?	
4	<b>Q</b> Next sentence, to reach the level of STP		MR. McDANIEL: You left the word 65 out.	
5	required to ensure the entire field has an STP level 11:19AM		MR. NANCE: If I did, I apologize. 11:22AM	
6	that provides 100 percent yield efficiency, the		MR. McDANIEL: Okay.	
7	total tons would be 505,515 tons. Do you know how		A Well, reading the sentence, it says that	
8	they arrived at that figure?		there's an average of 16.9 tons of poultry litter	
9	A I presume that's the -- assume the STP has to		per acre, and 70 percent of the litter required to	
10	be 120 over the entire field. So the additional 11:19AM		reach the STP of 65 had been land applied. So that 11:23AM	
11	amount needed to raise it from 65 to 120.		only 75 -- so that only represents 70 percent of the	
12	<b>Q</b> So that would basically be 100 points from		litter that was required to raise STP to 65.	
13	their baseline of 20?		<b>Q</b> Okay, and only -- so that means that if you	
14	A Basically, yes.		are assuming 20 as your baseline --	
15	<b>Q</b> Okay. To ensure an STP of 65 and 120 would 11:20AM		A Okay. 11:23AM	
16	require 11,446,443 tons and 16 -- excuse me,		<b>Q</b> -- and apply all the litter, I guess, that's	
17	11,446,443 tons and 16,850,499 tons of litter. Do		ever been produced in the watershed, then you're	
18	you know how they arrived at either one of those		only 70 percent of the distance from 20 to 65; is	
19	numbers?		that what that means?	
20	A No, I don't know the math behind how they got 11:20AM		A Yes. 11:23AM	
21	those numbers.		<b>Q</b> Okay, and I guess you're only 48 percent of	
22	<b>Q</b> Okay. Or 23 tons and 34 tons per fertilizable		the way from 20 to 120. Is that what the	
23	forage acre respectively. Do you know how they		parenthetical means?	
24	arrived at either one of those numbers?		A I understand that to mean that, yes.	
25	A No. 11:20AM		<b>Q</b> At these levels of production of phosphorus 11:24AM	
	332		334	

1 demands and supply, the average STP is estimated to  
2 be 45.5 pounds per acre. Is that a scientifically  
3 valid average that you are willing to back as a soil  
4 scientist?

5 MR. McDANIEL: Object to the form. 11:24AM

6 A No. As a soil scientist, I would want a lot  
7 more rigorous data to go into it.

8 Q Again, this estimation is based on the  
9 assumption that all the litter produced has been  
10 uniformly applied throughout the IRW fertilizable 11:24AM  
11 forage-producing acres, that litter has been the  
12 only additive source of phosphorus in the watershed,  
13 and that the data used is reflective of practices  
14 and enterprises in the IRW. Are those assumptions  
15 true? 11:25AM

16 A I don't know if necessarily true is the right  
17 word. I think they may be adequate for the purposes  
18 of their economic evaluation they're trying to make.  
19 For the purposes of this evaluation, it may be fine,  
20 but I don't know if you can call them true or not 11:25AM  
21 true.

22 Q Is it true that all of the litter produced in  
23 the Illinois River watershed has been uniformly  
24 applied over the acres of pasture in the watershed?

25 A My understanding, I wouldn't expect that to be 11:25AM

335

1 true.

2 Q In fact, that would be a shocking suggestion  
3 in your business, would it not?

4 A It would be. It would be a surprise.

5 Q Would it be a surprise in your profession as 11:25AM  
6 well to suggest that phosphorus litter has been the  
7 only additive source of phosphorus in the watershed?

8 A That would be a surprise.

9 Q And would it be fair to say that you're just  
10 not in a position to opine on the agricultural 11:26AM  
11 practices and enterprises in the IRW?

12 A That's correct.

13 Q Okay. This estimation should not be used to  
14 indicate that we have calculated an actual weighted  
15 average, median or any other measure of simple 11:26AM  
16 tendency of the current STP in the watershed. What  
17 does that sentence mean?

18 A I think it is basically saying that they don't  
19 have a lot of confidence that their estimate is  
20 actually representative of the physical soil 11:26AM  
21 properties.

22 Q Do you have any confidence that their estimate  
23 is actually representative of the physical soil  
24 property.

25 A No. If I was going to do a scientific 11:27AM

336

evaluation, it would be much more rigorous and  
require much more data than what they've used in  
this economic comparison.

Q Nevertheless, in Paragraph 10C of your report,  
Dr. Coale, you say, I agree with the methodology 11:27AM  
used as outlined in Appendix A to estimate poultry  
litter generation, forage nutrient P utilization,  
baseline soil test P average -- values, soil test P  
response to poultry litter application to  
pastureland and poultry litter available for P-based 11:27AM  
land application in the IRW. Is there anything  
about that agreement you would like to modify now?

MR. McDANIEL: Object to the form.

A Well, it's not modified. Well, just as I said  
in the beginning, understand where -- what the 11:27AM  
purpose was. The purpose was these individuals came  
to me and said we're doing an economic analysis of  
ag production systems in the IRW. We need to make  
certain assumptions and generalities, and for the  
purposes of that economic analysis, their 11:28AM  
methodology is fine. I've seen worse. I certainly  
wouldn't say that's the methodology I would use for  
a rigorous scientific evaluation. I think there's a  
big difference in how you approach it. So I'm  
saying from what their goal was, that's a fine way 11:28AM

337

to take an estimate at it for their purposes.

Q But you were the scientific advisor on the  
soil science part of this exercise; right?

A For the purposes I just outlined, yes.

Q What do you understand their purposes to have 11:28AM  
been in this exercise?

A They wanted to be able to take this  
information and then apply economic assessments,  
dollars -- cash in, cash out -- I never saw that  
part so I don't know what they're doing; that's my 11:29AM  
assumption -- to get a value on the litter that was  
in the watershed available, what it would do to the  
soil test P. It was applied on very general terms,  
hay production, forage production, animal  
production. It was a very general economic 11:29AM  
analysis.

Q And for that, they used a very general  
agronomic average of things that we've gone through  
here?

A Yes. 11:29AM

Q And that's valid?

A I've seen it done at that level for economic  
analysis before, and usually when you read an  
economic analysis like that, they lay out right  
upfront what the assumptions are, and a lot of times 11:29AM

338

1 the physical scientists look at those assumptions  
2 and say that's a ridiculous assumption, that's a  
3 fair assumption, they weigh each one, and these are  
4 the assumptions they made. If they wanted to do the  
5 calculations, I understood where they were going and 11:29AM  
6 I thought their methodology was okay.  
7 **Q Can you tell me any more than you have about**  
8 **the economic purpose they were trying to achieve**  
9 **with this analysis?**  
10 A I think I've told you all I understand about 11:30AM  
11 it.  
12 **Q You've endorsed this STP average method to be**  
13 **used for Rausser and Dicks. Doesn't that mean that**  
14 **it could have some validity looking at an entire**  
15 **watershed in terms of STPs on an average basis?** 11:30AM  
16 MR. McDANIEL: Object to the form.  
17 A No. It's getting the cart before the horse  
18 here. I mean, it was presented to me from these  
19 authors that they needed to do it this way, and I  
20 think we even had a conversation about that's not 11:30AM  
21 the way it should be done; you can't average things  
22 like this; it shouldn't be done that way from a  
23 scientific rigorous evaluation point of view, and  
24 they said, well, we know that but we have to do it  
25 for the economic analysis, and I said, well, then 11:31AM  
339

1 let's proceed, but I have a problem with that, and I  
2 told that to them during the conversation we had.  
3 **Q So you told them that you had a problem with**  
4 **the science underlying their assumptions?**  
5 MR. McDANIEL: Object to the form. 11:31AM  
6 A I was saying that for the purpose of a  
7 scientific evaluation, that's not an adequate  
8 approach, but they told me for their purpose of  
9 economic evaluation, they deemed it to be adequate,  
10 and I said, well, as long as we understand there's a 11:31AM  
11 difference there, then let's go forward.  
12 **Q Your report says you agree with their**  
13 **methodology, not for any economic purpose, but for**  
14 **estimating soil litter -- estimating poultry litter**  
15 **generation and all of these other things. Are you** 11:31AM  
16 **willing to stand by the science they have used for**  
17 **poultry litter generation, nutrient forage,**  
18 **phosphorus utilization, all of the things in 10C in**  
19 **your report?**  
20 MR. McDANIEL: Object to the form. 11:32AM  
21 A For the purposes that they expressed to me,  
22 what they wanted to do with it, that's as good as  
23 they needed to have it.  
24 **Q But you're not willing to stand behind these**  
25 **things scientifically, are you?** 11:32AM  
340

A I don't think you can make the same  
assumptions in a valid scientific assessment, no,  
sir. You have to be much more precise and much more  
rigor.  
**Q Is there any understanding in your field, Dr. 11:32AM**  
**Coale, about how far on average litter is**  
**transported from where it's generated to where it's**  
**applied?**  
A The only study I've seen that looked at that  
was a study done in Maryland by an economist who 11:33AM  
looked at the cost benefit analysis of transporting  
litter, and I believe, and I'm reaching far back in  
memory here, I believe they found it was -- at the  
current prices of diesel and everything else at the  
time, whatever went into that assessment, they found 11:33AM  
seven miles to be a reasonable distance to move it.  
**Q Have you seen any study similar to that in the**  
**Illinois River watershed?**  
A I have not.  
**Q Let me show you, Dr. Coale, what I'm marking 11:33AM**  
**as Plaintiff's Exhibit 13, but before I do that, as**  
**we went through Appendix A, which was part of**  
**Exhibit 12, did you see anything in it that had**  
**changed from the draft form you originally looked**  
**at?** 11:34AM  
341

A I wasn't doing a word-by-word comparison, but  
I didn't notice any change.  
**Q Dr. Coale, that just happens to be my copy of**  
**the final part of Subpart E that I think you did**  
**look at.** 11:34AM  
A Okay.  
**Q Are you familiar with what I've marked as**  
**Exhibit 13?**  
A Yes.  
**Q All right, and I'll represent to you I've 11:35AM**  
**extracted that from the final draft of the Rausser**  
**and Dicks report. Okay?**  
A Okay.  
**Q Because you mentioned it in your report.**  
**Let's look on page -- the pages are numbered on the 11:35AM**  
**bottom. On the bottom of Page 26, you get the word**  
**the and then you carry over on to 27. The first**  
**question is whether the datasets are accurate, and**  
**the second is whether they are representative, and**  
**we're talking about Gordon Johnson's datasets here.** 11:36AM  
A Okay.  
**Q Do you recall that?**  
A Yes, I do.  
**Q Okay, and Rausser and Dicks criticized Dr.**  
**Johnson's data as not being representative of the 11:36AM**  
342



1 entire watershed; is that correct?  
2 A That's correct.  
3 Q Okay. Maybe before we get there, we ought to  
4 look at the datasets he talks about. Let's go back  
5 to 26, and right under the heading, data errors and 11:36AM  
6 deficiencies, it says, he, Dr. Johnson, relies on at  
7 least four datasets. One, two years, 2006 to 2007,  
8 of soil tests collected in the Eucha-Spavinaw  
9 watershed. Did you look at that data yourself?  
10 A I've seen that data. 11:36AM  
11 Q Okay. Two, soil test reports, 2000 to 2005,  
12 submitted by poultry producers who applied poultry  
13 litter to their land and who contracted with two  
14 integrators, George's and Tyson. Did you look at  
15 that data as well? 11:37AM  
16 A I've seen that data.  
17 Q Okay. Three then is evidently sets of data,  
18 one from the Oklahoma State University and the other  
19 from University of Arkansas, which record tests  
20 performed over a seven-year period, they say 11:37AM  
21 principally to assure that excess litter is not  
22 applied in recent years, but they were publicly  
23 available data from Arkansas and Oklahoma that Dr.  
24 Johnson looked at.  
25 A Correct. 11:37AM

343

1 Q And did you look at that data as well?  
2 A Yes, I saw those.  
3 Q Okay. Is that kind of soil test data that you  
4 looked at from Dr. Johnson comparable to the kind of  
5 soil test data you look at in Maryland? 11:37AM  
6 MR. McDANIEL: Object to the form.  
7 A Look more commonly at -- the one I don't -- I  
8 don't know if I've ever in the past looked at one  
9 that was like from the integrator, whole company  
10 averages and stuff like that. 11:38AM  
11 Q Right.  
12 A But, yes.  
13 Q But in terms of gathering the data in the  
14 field and sending it to the lab, is it the same kind  
15 of data that you look at in Maryland? 11:38AM  
16 A Yes.  
17 Q Do you have any reason to believe that any of  
18 this data that Dr. Johnson looked at is not reliable  
19 in that it doesn't accurately represent the soil  
20 being tested? 11:38AM  
21 A Well, I suspect they are results from soil  
22 test analysis. So, yes, the soil has been tested.  
23 That's the assumption I had.  
24 Q Okay, and is this the kind of soil test data  
25 that people in your profession would work with 11:38AM

344

1 routinely?  
2 A Yes and no. Yes, if you're trying just to  
3 look at large databases of soil tests that other  
4 people took for varying purposes and applications.  
5 You can look at datasets like this and use them. If 11:38AM  
6 you are trying to do a scientific study, you have to  
7 have a much more controlled dataset.  
8 Q So for things like finding compliance with the  
9 nutrient management plan, would this kind of data be  
10 adequate for farmers? 11:39AM  
11 A I guess it really depends on what defines what  
12 is in compliance versus out of compliance. It may  
13 not.  
14 Q Okay. Do you have any reason to believe that  
15 it's not as far as either the State of Oklahoma or 11:39AM  
16 the State of Arkansas is concerned?  
17 MR. McDANIEL: Object to the form.  
18 A I don't know about that.  
19 Q Okay. Then there was a question of whether or  
20 not the data was representative. 11:39AM  
21 A Correct.  
22 Q What is your understanding of the reason this  
23 data was collected, and if we need to go back, you  
24 know, point by point, we can.  
25 A In general, the reason data like this is 11:39AM

345

1 collected is by producers, they take soil samples,  
2 send them to a lab, get the analysis back with  
3 recommendations so they can make management  
4 decisions on what to do next on that piece of land.  
5 Q Okay. Is the sort of data that Dr. Johnson 11:40AM  
6 looked at representative of the kind of fields that  
7 are being tested for that very purpose?  
8 MR. McDANIEL: Object to the form.  
9 Q To make management decisions on those fields?  
10 MR. McDANIEL: Same objection. 11:40AM  
11 A I presume they were collected to make  
12 management decisions.  
13 Q Okay. So would you be comfortable that they  
14 fairly represent the fields where people are  
15 collecting data to make management decisions, 11:40AM  
16 particularly for phosphorus?  
17 MR. McDANIEL: Object to the form.  
18 A Again, with our premise that the reason you  
19 take a soil sample and send it to a commercial lab  
20 for commercial analysis to begin with is to make 11:40AM  
21 management decisions, then the answer would be yes.  
22 Q And would the same answer be true if you were  
23 sending it to a university lab for the same purpose?  
24 A Yes, yes.  
25 Q On Page 29 Rausser and Dicks have a heading 11:41AM

346

1 that says improper statistical techniques. Do you  
2 see that?  
3 A Yes, I do.  
4 Q Okay. In the second sentence they say he,  
5 being Dr. Johnson, asserts that any test sample with 11:41AM  
6 an STP of 65 or above represents a field that has no  
7 need of phosphorus. This is simply wrong. Now,  
8 what's the agronomic limit in Oklahoma?  
9 A It's set at 65.  
10 Q Okay. So as far as that goes, Dr. Johnson is 11:42AM  
11 correct, at least for Oklahoma samples?  
12 MR. McDANIEL: Object to the form.  
13 A It says if the agronomic limit in Oklahoma is  
14 65 pound per acre, then above that it would assume  
15 you don't have a need for phosphorus to be applied 11:42AM  
16 to that field.  
17 Q Okay.  
18 A What they're looking at here is the reference  
19 from -- it was an OSU Extension publication, I  
20 believe, that said to ensure that you have 65 pounds 11:42AM  
21 per acre STP over every square inch of a field, then  
22 to assure that, then you should really have a soil  
23 test P level of 120. I think that's what they are  
24 getting at that there.  
25 Q I think that's what they are getting at that 11:42AM  
347

1 there, and they also point out that in the state of  
2 Oklahoma, I'm not sure they say it, but in a  
3 nutrient limited watershed, the STP limit is 300.  
4 That's something we've talked about before; right?  
5 A Yes, we have. 11:43AM  
6 Q Okay. You have looked at Dr. Johnson's report  
7 and the data that support it?  
8 A Yes.  
9 Q Do you think that he was being deceptive to  
10 use 65 as he used it? 11:43AM  
11 A No.  
12 Q So would you agree with -- you would disagree  
13 with their conclusion in the final sentence of the  
14 first paragraph under heading number two?  
15 A No. I believe that the soil test P level of 11:43AM  
16 65 is the established critical level for agronomic  
17 response.  
18 Q And where they say he is, therefore,  
19 deceptive, you disagree with that?  
20 A I don't think referring to that 65 is a 11:43AM  
21 deceptive practice.  
22 Q Okay. Then they talk about using simple  
23 averages or means after that.  
24 A Right.  
25 Q And that there's a possibility that that 11:44AM  
348

average could give a false impression?  
A Correct.  
Q Turning over to Page 30, do you know which  
average that Dr. Johnson did, if any, contained in  
it a negative STP value? 11:44AM  
A I did see in some of the spreadsheets of data  
that he had that he referenced negative values.  
Q Do you know whether those negative values  
ended up in any average he did?  
A I have no knowledge on that. 11:44AM  
Q Okay. Same question about values exceeding  
15,000.  
A Okay.  
Q Do you know if he did any average in any of  
his report that included a value of 15,000? 11:44AM  
A No. Again, I saw values that high in the  
datasets.  
Q Right.  
A But whether they were in the report or not, I  
don't know. 11:45AM  
Q If you get the dataset of all of the tests for  
the whole state, you're going to get a lot of data,  
some of which may or may not have been used by Dr.  
Johnson?  
A I don't recall him specifically saying whether 11:45AM  
349

or not he gleaned certain numbers out of the dataset  
before he did his calculations or not.  
Q Okay. Would you agree that reading a 15,000  
is a laboratory or sampling error?  
A There's some error involved there. It's not 11:45AM  
realistic.  
Q Or maybe someone sending in just a sample of  
fertilizer to be tested?  
A There's any number of possibilities, but it's  
not a realistic number. 11:45AM  
Q Okay. They criticized Dr. Johnson for giving  
equal weight to each observation. I'm not sure  
which ones they say are plainly erroneous, but I  
guess they're saying he should have done a weighted  
average there in the middle of the page. In your 11:46AM  
view, did his failure to do a weighted average by  
the acreage involved in each sample, does it make  
his averages completely devoid of any value?  
A It can -- I've worked with datasets like this.  
It can make them have a very different meaning. You 11:46AM  
can have a very small acreage -- let's say you have  
a single acre that you have a soil sample from that  
might happen to be a loafing level in a pasture  
where the STP level is extremely high. Well,  
instead of attributing that extremely high soil test 11:46AM  
350

1 P level to that single acre, you're attributing to  
2 the percent of the entire land area, divided by the  
3 number of samples you have. You don't know. So it  
4 could be grossly over represented or on the  
5 contrary, you could have a single soil sample that 11:47AM  
6 represents 100 acres that has an STP value that's  
7 very low, but it may not be representative of the  
8 right proportion of the landscape. So this is  
9 something that -- just not in this case but it's  
10 many, many times over the years, it's been a problem 11:47AM  
11 of if you are going to use a collection of data  
12 regarding soil test analyses numbers and you're  
13 going to try to make an assumption what it means  
14 over a larger land area, you really have to know the  
15 number of acres that corresponds with each 11:47AM  
16 individual sample, and that would be an area  
17 weighted sample. If you don't, you can have some  
18 very misleading answers come out. That's a flaw.  
19 **Q Okay. Let's look at Page 32, if we could,**  
20 **please, Figure 6. Now, this is something that 11:47AM**  
21 **Rausser and Dicks did rather than something Dr.**  
22 **Johnson did; right?**  
23 A Yes. That's what I understand.  
24 **Q All right, and do I understand correctly that**  
25 **they used basically the Benton and Washington County 11:48AM**  
351

1 **data that Dr. Johnson had gathered from Arkansas?**  
2 A That's what I understand the caption to say,  
3 yes.  
4 **Q And would you be willing to trust that Rausser**  
5 **and Dicks correctly plotted that on their graph, 11:48AM**  
6 **which is Figure 6?**  
7 A I didn't independently verify it.  
8 **Q Okay. Fair enough. First of all, do you see**  
9 **on this particular graph any value of 15,000 showing**  
10 **up? 11:48AM**  
11 A No, sir. It's off the range of the scale.  
12 **Q Okay, and do you see any value that's**  
13 **negative?**  
14 MR. McDANIEL: Object to the form. It's  
15 misleading. 11:49AM  
16 **Q Okay. Do you see any value shown on their**  
17 **graph that would indicate a negative STP?**  
18 MR. McDANIEL: Same objection.  
19 A The X axis scale doesn't go below -- I assume  
20 it goes to zero. It doesn't go below two indicated 11:49AM  
21 here.  
22 **Q Now, explain to me, if you would, please --**  
23 **well, do you see along the bottom, along the X axis**  
24 **a hash mark of 63?**  
25 A Yes. 11:49AM  
352

**Q Okay. If we assume that 65 were about a hair**  
**to the right of that --**  
A Okay.  
**Q -- would it be fair to say that the**  
**overwhelming majority of those readings would be 11:49AM**  
**above 65?**  
MR. McDANIEL: Object to the form as  
misleading.  
A I would say the majority of those data points  
represented here would be above 65. 11:50AM  
**Q Okay. I see a hash mark for 101. If we were**  
**to assume that 100 were the agronomic limit in**  
**Arkansas, would most of the data points represented**  
**on Figure 6 still be in excess of 100?**  
A From this figure, I'd say yes. 11:50AM  
**Q Okay, and they have a hash mark along the X**  
**axis for 120, do they not?**  
A Yes.  
**Q Okay. Assuming the 120 might have some value**  
**in our analysis, are most of the data points 11:50AM**  
**represented on Figure 6 in excess of 120?**  
A That's getting to the point where I'm less  
confident to say yes or no because you really have  
to count the observations. It's getting -- it's not  
clearly as obvious whether it is or not as you work 11:51AM  
353

your way up the right of this X axis.  
**Q Do you understand that each bar here to be a**  
**separate observation?**  
A No. I believe each bar -- the height of the  
bar represents how many observations of that value. 11:51AM  
**Q Okay. What is the median then on Figure 6;**  
**what does that mean?**  
A That if you rank all the observations from the  
least to the greatest in value, that would be the  
middle point in that ranking. 11:51AM  
**Q All right. Does that mean that from the**  
**median, there are as many observations less than the**  
**median as there are above the median?**  
A That's what it would mean.  
**Q Okay, and if the median is in excess of 120, 11:52AM**  
**could we then conclude that there are more than half**  
**at least that are in excess of 120?**  
A Yes, you can conclude that.  
**Q And so back to my question a moment ago. Most**  
**of the values shown on this Figure 6 are going to be 11:52AM**  
**above 120?**  
A Yes.  
**Q They talk -- the text below Figure 6 about the**  
**four Oklahoma counties, and Sequoyah gets put back**  
**in; do you see that; Adair, Cherokee, Delaware and 11:53AM**  
354

1 Sequoyah?

2 A I see that list, yeah.

3 Q Do you know why they put Sequoyah in here but

4 left it out of the last exhibit we talked about with

5 STPs and chickens and turkeys and all of that? 11:53AM

6 A I have no idea.

7 Q Back to chickens and turkeys a minute. Do

8 turkeys poop more or less than chickens?

9 MR. McDANIEL: Object to the form.

10 A With the assumption that their excrement is 11:53AM

11 related to body size, I would expect it to be more.

12 Q Okay. Is that something that you have studied

13 or quantified or worked with in your work?

14 A No, sir.

15 Q But just a common sense assumption knowing how 11:54AM

16 big a turkey is and how big a chicken is?

17 A That's my assumption.

18 Q Okay, and do I remember correctly that you

19 said Rausser and Dicks looked like they left turkeys

20 out of Exhibit 12, Appendix A? 11:54AM

21 MR. McDANIEL: Object to the form.

22 A I believe one of the footnotes indicated that

23 turkeys were omitted.

24 Q Okay. On Page 33, the first full paragraph,

25 they have a sentence that says, the rate of poultry 11:54AM

355

1 litter production in the IRW is adequate but not

2 excessive to meet these needs, and I assume they're

3 talking about the needs for phosphorus.

4 Approximately one million tons of litter would be

5 required to cover all of the forage-producing 11:55AM

6 491,246 acres of hay and pasture in the five-county

7 area each year. Now we're back to only five

8 counties. Is that, once again, assuming that every

9 pasture acre in the watershed is going to get two

10 tons of litter? 11:55AM

11 A That's my assumption, that they made that

12 assumption, a double assumption. That's my

13 understanding that that's the assumption they made.

14 Q Okay. Is that assumption realistic in the

15 real world? 11:55AM

16 A In the real world, I wouldn't expect even

17 distribution of litter over every acre uniformly.

18 Q And I think we talked about yesterday nobody

19 has gathered data about the number of acres in the

20 watershed that have an unmet need for litter? 11:56AM

21 A Not that I know of.

22 Q Okay. Would it be fair to assume that there

23 are some pasture acres in the watershed where the

24 owner or the operator doesn't want litter?

25 A I would suspect that occurs, yes. 11:56AM

356

Q Okay, and we don't know to what extent it

occurs?

A Correct.

Q Or at least you don't?

A I don't. 11:56AM

Q And we don't know anybody who does?

A I don't know what you know.

Q Dr. Coale, are you aware that regulators in

the state of Arkansas have determined that

Washington and Benton Counties have a surplus of 11:57AM

nutrients produced in those counties over and above

what is needed there?

A I've not seen that information.

Q Would it surprise you if I represented that to

you is the case? 11:57AM

MR. McDANIEL: Object to the form.

A I would be more comfortable if I read it in a

publication somewhere.

Q But nobody in helping you get ready in all of

these WebEx conferences offered that to you, did 11:57AM

they?

A Not that I recall.

Q Have you seen a paper by a scientist named

Slanton (sic) from Arkansas in about 2004 that came

to that conclusion? 11:57AM

357

A I don't recall.

Q Okay. On Page 33, Dr. Coale, the final

heading is changing regulatory environment, and

Rausser and Dicks say that Dr. Johnson takes no

account of the changing litter application practices 11:58AM

in the IRW which have been implemented over recent

years, and they detail in, I guess, Section 6 of

their report what they consider to be changing

regulatory environment about litter. Did you look

at the substantive part of their report that dealt 11:58AM

with the changing regulatory environment?

A No, I did not.

Q Okay. Are you in agreement then with them in

the very last sentence of their paragraph on

changing regulatory environment that Dr. Johnson's 11:59AM

failure to consider the effect of those changes

renders his conclusions worthless?

MR. McDANIEL: Object to the form. It's

outside the scope of his report.

A I haven't even considered their discussion of 11:59AM

the changes in regulatory environment.

Q Okay. So you certainly can't vouch for their

assessment that Dr. Johnson's work is worthless

because he didn't consider it?

A No. That part I didn't even consider. 11:59AM

358

1 **Q And so in Paragraph 10C of your report where**  
 2 **you say you reviewed Section E of the Rausser and**  
 3 **Dicks report, which is what we've been talking about**  
 4 **as Exhibit 13 --**

5 A Right, correct. 11:59AM

6 **Q -- you're going to exempt from your agreement**  
 7 **with that any conclusion that his work is worthless**  
 8 **because he didn't consider the regulatory**  
 9 **environment?**

10 A Right. 11:59AM

11 MR. McDANIEL: I object. I object to the  
 12 form. His report says what part of Section E he  
 13 considered. It speaks for itself.

14 MR. PAGE: I thought we weren't going to do  
 15 speaking objections, Scott. I was in a deposition 12:00PM  
 16 the other day with Dr. Stevenson, and I was advised  
 17 that if I said anything beyond object to the form,  
 18 that was improper. I've noticed in the three hours  
 19 I've been here today or two and a half hours, you've  
 20 gone well beyond that in your objections. Is it 12:00PM  
 21 going to be your practice to continue giving these  
 22 speaking objections during depositions of your  
 23 experts?

24 MR. McDANIEL: You can say whatever you  
 25 want on the Record, David. I'm not going to get in 12:00PM

359

1 an argument with you. Go ahead. Next question.

2 **Q Let's look at Paragraph 10D of your report,**  
 3 **which is there on 17, Dr. Coale, and let's look at**  
 4 **the last two sentences of that paragraph, and**  
 5 **it's -- you're talking about Section E of the 12:01PM**  
 6 **Rausser and Dicks report in that paragraph, are you**  
 7 **not?**

8 A Okay, correct.

9 **Q Okay, and conclude with any sampling plan or**  
 10 **area -- excuse me. Any estimation of the soil P 12:01PM**  
 11 **status of the IRW must begin with a statistically**  
 12 **valid field sampling plan or an area-weighted soil**  
 13 **type specific and management history specific data**  
 14 **collection plan. Did I read that correctly?**

15 A Yes, you did. 12:01PM

16 **Q Did Rausser and Dicks do that?**

17 A No, sir.

18 **Q And yet you approved their methodology, didn't**  
 19 **you?**

20 MR. McDANIEL: Object to the form. 12:01PM

21 A I talked about the methodology we talked about  
 22 earlier was that -- how they approached to do their  
 23 economic analysis. This is referring to if you are  
 24 going to do a scientifically rigorous evaluation,  
 25 you have to follow a different procedure. 12:02PM

360

**Q Okay. I'm going to read to you what you said**  
**in 10C about their Appendix A, which was Exhibit 12.**  
**I agree with the methodology used as outlined in**  
**Appendix A to estimate poultry litter generation,**  
**forage nutrient P utilization, baseline soil test P 12:02PM**  
**values, soil test P response to poultry litter**  
**application to pastureland and poultry litter**  
**available for P-based land application in the IRW.**

**Do you see that?**

A Yes, I see that. 12:02PM

**Q And they didn't do any statistically valid**  
**field tests, did they?**

A Well, probably that was my mistake when I  
 wrote this by not prefacing by saying for the  
 purposes of their broad brush economic evaluation, 12:02PM  
 that I thought their methodology was fine. I  
 probably should have been more specific to what I  
 was referring to.

**Q Because in the report that you wrote and you**  
**submitted, you're a lot harder on Dr. Johnson than 12:03PM**  
**you are on Rausser and Dicks, aren't you?**

MR. McDANIEL: Object to the form.

A I wouldn't call it being hard or not being  
 hard. I just -- I interpreted what Dr. Dicks and  
 Rausser was doing as being a lighter, less rigorous 12:03PM

361

evaluation for economic purposes, which we commonly  
 see, and I interpreted what Dr. Johnson was doing as  
 being a scientific evaluation of data, which you  
 have to take much more care doing that.

**Q Okay.**

A I think two people had different objectives,  
 different goals and different uses, even if they  
 were using the same data.

**Q Your last sentence in 10D, Dr. Johnson did not**  
**utilize statistically valid approaches to estimating 12:03PM**  
**the soil test P status in the IRW.**

A That's correct.

**Q Rausser and Dicks did not use statistically**  
**valid approaches for estimating the soil test P**  
**status in the IRW either, did they? 12:04PM**

A For their purposes.

**Q Answer my question, please.**

A No, they did not.

**Q Yet you agree with their methodology?**

A For their purposes. 12:04PM

**Q You were their scientific advisor for soil**  
**test matters; right?**

A I was not their advisor. They ran their plan  
 by me to see whether they could -- if they were  
 going to do this broad brush economic evaluation, 12:04PM

362

1 did I think their approach and methodology was  
2 valid, and I said yes, and that's about the extent  
3 of our conversation.

4 **Q So you would not want the court to think that**  
5 **you have validated the scientific component of their** 12:04PM  
6 **Appendix A based upon what you wrote in your report?**

7 MR. McDANIEL: Object to the form.

8 A I believe if you are going to do a scientific,  
9 rigorous scientific evaluation and try to get a  
10 defensible number, you could not use the approach 12:05PM  
11 they used.

12 **Q 10E, Dr. Gordon Johnson's poorly justified and**  
13 **all-inclusive conclusion that application of poultry**  
14 **litter to grass pastures in the IRW constitutes poor**  
15 **agronomic practice is not useful when the goal of** 12:05PM  
16 **water quality protection is dependent on**  
17 **implementation in changes in farm management. Well,**  
18 **here you are expressing an opinion on water quality.**

19 A No, I'm not. I'm saying that --

20 **Q On the -- on farm management necessary to** 12:05PM  
21 **ensure the goals of water quality protection?**

22 A Right.

23 **Q So the P risk index is the -- quantifies the**  
24 **-- or tries to, the risk or the danger of phosphorus**  
25 **causing a water quality problem; right?** 12:06PM

363

1 A What it does is --

2 **Q Well, does the P risk index try to quantify**  
3 **the risk of phosphorus injury to water?**

4 A Okay. What is a P risk index?

5 **Q A phosphorus index.** 12:06PM

6 A Okay. A phosphorus site index is designed to  
7 evaluate the relative risk for phosphorus movement  
8 off of a site, off of a field.

9 **Q And to water?**

10 A The degree of conductivity of that field to a 12:06PM  
11 water body is assessed when you are doing the  
12 phosphorus index evaluation.

13 **Q And the degree of conductivity is assessed**  
14 **because you are trying to find out the risk of**  
15 **phosphorus leaving that field and getting to water?** 12:07PM

16 A Correct.

17 **Q Dr. Coale, is there -- based upon your study**  
18 **and knowledge and expertise, is there any watershed**  
19 **in America that has an environmental problem, a**  
20 **water quality problem because of poultry litter** 12:07PM  
21 **phosphorus?**

22 MR. McDANIEL: Object to the form.

23 A I've not seen that data, no.

24 **Q So in all of your expertise and your teaching**  
25 **and your studying, you haven't found any watershed** 12:07PM

364

**in the United States of America that has an**  
**environmental water quality problem because of**  
**phosphorus from poultry litter?**

MR. McDANIEL: Object to the form.

A I believe that where there are water quality 12:08PM  
problems due to elevated phosphorus levels in water,  
there are cases where poultry has been implicated as  
one of the possible sources.

**Q Is the Illinois River watershed one of those**  
**watersheds where it's been implicated as a potential** 12:08PM  
**source?**

A I believe it has.

**Q Dr. Coale, is there any watershed in the**  
**United States that you're aware of where the**  
**employment of a phosphorus index has improved water** 12:08PM  
**quality?**

A Not specifically.

MR. NANCE: Let's take a quick break.

VIDEOGRAPHER: We are now off the Record.

The time is 12:10 p.m. 12:08PM  
(Following a short recess at 12:10  
p.m., proceedings continued on the Record at 12:17  
p.m.)

VIDEOGRAPHER: We are back on the Record.

The time is 12:17 p.m. 12:15PM

365

**Q Dr. Coale, is poultry litter used after it**  
**becomes litter any further in raising poultry?**

A It can be.

**Q How?**

A As a fertilizer for grain crops that are being 12:16PM  
fed back to the poultry.

**Q Is that the only way it could be used?**

A That's the only way that comes to mind right  
now to me.

**Q All right. Sir, have you done any** 12:16PM  
**consultation with farmers or poultry producers in**  
**the IRW?**

A No, sir.

**Q Okay. Have you done any consultation with**  
**farmers or poultry producers in all of Oklahoma or** 12:17PM  
**Arkansas?**

A No, sir.

**Q Have you made any extension-type presentations**  
**in either Oklahoma or Arkansas?**

A The only time I can imagine would have been I 12:17PM  
was at a conference in Fayetteville maybe seven  
years ago, but it wasn't an extension-type  
presentation. It wasn't to farmers or growers.

**Q Did you make -- did you present a paper or**  
**something?** 12:17PM

366



<p>A I can't remember if I presented or not or whether I just attended.</p> <p><b>Q Okay. Have you had any consultations with employees of the State of Arkansas about this lawsuit?</b> 12:17PM</p> <p>A Not that I know of.</p> <p><b>Q Have you done any work that's been used by anyone else in this case or have you looked at anything in this case that we haven't already talked about in your deposition?</b> 12:18PM</p> <p>A I believe I provided everything I considered.</p> <p><b>Q Well, Dr. Coale, I don't think I have anything else.</b></p> <p>MR. McDANIEL: On behalf of Peterson, I don't have any questions. Shaking heads in the room. Anyone on the phone? Bob? Anyone else have questions for the witnesses? 12:18PM</p> <p>MR. SANDERS: No questions here.</p> <p>MR. McDANIEL: Dr. Coale wants to read and sign, and you can send it to me, please, Lisa. 12:19PM</p> <p>VIDEOGRAPHER: This concludes the deposition of Frank Coale. We are now off the Record. The time is 12:20 p.m.</p> <p>(Whereupon, the hearing was recessed at 12:20 p.m.) 12:19PM</p> <p>367</p>	<p>C E R T I F I C A T E</p> <p>STATE OF OKLAHOMA )  ) ss. COUNTY OF TULSA )</p> <p>I, Lisa A. Steinmeyer, Certified Shorthand Reporter within and for Tulsa County, State of Oklahoma, do hereby certify that the above named witness was by me first duly sworn to testify the truth, the whole truth and nothing but the truth in the case aforesaid, and that I reported in stenograph his deposition; that my stenograph notes were thereafter transcribed and reduced to typewritten form under my supervision, as the same appears herein.</p> <p>I further certify that the foregoing 114 pages contain a full, true and correct transcript of the deposition taken at such time and place.</p> <p>I further certify that I am not attorney for or relative to either of said parties, or otherwise interested in the event of said action.</p> <p>WITNESS MY HAND AND SEAL this 20th day of January, 2009.</p> <p>LISA A. STEINMEYER, CRR CSR No. 386</p> <p>369</p>		
<p>SIGNATURE PAGE</p> <p>I, Frank Coale, PhD, do hereby certify that the foregoing deposition was presented to me by Lisa A. Steinmeyer as a true and correct transcript of the proceedings in the above styled and numbered cause, and I now sign the same as true and correct.</p> <p>WITNESS my hand this _____ day of _____, 2009.</p> <p>FRANK COALE, PhD</p> <p>SUBSCRIBED AND SWORN TO before me this _____ day of _____, 2009.</p> <p>Notary Public</p> <p>My Commission Expires:</p> <p>368</p>	<p>CORRECTIONS TO THE DEPOSITION OF FRANK COALE, PhD Volume II</p> <table><thead><tr><th>PAGE AND LINE NUMBER</th><th>CORRECTION</th></tr></thead></table> <p>370</p>	PAGE AND LINE NUMBER	CORRECTION
PAGE AND LINE NUMBER	CORRECTION		

A		
<p><b>ability</b> 282:5</p> <p><b>able</b> 261:9,16 271:10 338:7</p> <p><b>absolutely</b> 267:12</p> <p><b>acceleration</b> 265:21</p> <p><b>accepted</b> 275:25</p> <p><b>account</b> 264:6 314:6 358:5</p> <p><b>accounted</b> 264:8 305:3</p> <p><b>accounting</b> 320:11</p> <p><b>accuracy</b> 304:1</p> <p><b>accurate</b> 301:17 302:3,13,19 342:18</p> <p><b>accurately</b> 304:20 344:19</p> <p><b>achieve</b> 272:3 330:3 339:8</p> <p><b>acidic</b> 263:22</p> <p><b>acknowledge</b> 294:24</p> <p><b>acre</b> 258:14 264:17 267:15,22 267:24 268:25 269:6,18 277:25 297:6 298:8 320:5 324:8 328:2 329:6,11,17 332:23 333:14,21,22,24 334:9 335:2 347:14,21 350:22 351:1 356:9,17</p> <p><b>acreage</b> 324:7 350:17,21</p> <p><b>acres</b> 295:22 296:11 322:17 322:17,18 324:2 327:10 330:20,24 333:8,15,23 334:2 335:11,24 351:6,15 356:6,19,23</p> <p><b>act</b> 325:20</p> <p><b>action</b> 369:21</p> <p><b>active</b> 325:11,13</p> <p><b>actual</b> 301:16,22,24 311:20 320:10 336:14</p> <p><b>Adair</b> 303:10 321:8 354:25</p> <p><b>added</b> 259:5</p> <p><b>adding</b> 266:20</p> <p><b>addition</b> 305:14</p> <p><b>additional</b> 266:20 269:24 332:10</p> <p><b>additive</b> 335:12 336:7</p> <p><b>adequacy</b> 291:9</p> <p><b>adequate</b> 335:17 340:7,9 345:10 356:1</p>	<p><b>adjoining</b> 263:17</p> <p><b>adjust</b> 264:6 281:25</p> <p><b>admit</b> 287:1 318:20</p> <p><b>advise</b> 291:19,25</p> <p><b>advised</b> 281:12 359:16</p> <p><b>advisor</b> 338:2 362:21,23</p> <p><b>affirmative</b> 308:13</p> <p><b>aforesaid</b> 369:11</p> <p><b>ag</b> 337:18</p> <p><b>ago</b> 295:11 328:24 354:19 366:22</p> <p><b>agree</b> 300:10 301:1 305:6 313:12 337:5 340:12 348:12 350:3 361:3 362:19</p> <p><b>agreeable</b> 292:9</p> <p><b>agreed</b> 293:20</p> <p><b>agreement</b> 303:4 337:12 358:13 359:6</p> <p><b>agricultural</b> 291:14 300:17 303:8,13,17 304:8 321:13 323:5 336:10</p> <p><b>agricultural-related</b> 294:1</p> <p><b>Agriculture</b> 295:19,23</p> <p><b>agronomic</b> 259:8 264:10,12 264:17,24 265:1 266:18 267:1 300:6,7 338:18 347:8 347:13 348:16 353:12 363:15</p> <p><b>agronomically</b> 259:1 265:11</p> <p><b>ahead</b> 287:3 288:10,11 331:14 360:1</p> <p><b>al</b> 254:11 279:5</p> <p><b>allow</b> 259:7</p> <p><b>allowance</b> 304:20</p> <p><b>allowed</b> 269:15</p> <p><b>allows</b> 327:3</p> <p><b>all-inclusive</b> 363:13</p> <p><b>America</b> 364:19 365:1</p> <p><b>amount</b> 259:1 271:9,10 275:7 296:21 298:9 303:1 305:15 309:22 316:4,5 317:5 319:9 322:5 327:16 330:21 332:11</p> <p><b>amounts</b> 297:8</p> <p><b>AmSouth</b> 255:18</p> <p><b>analyses</b> 351:12</p>	<p><b>analysis</b> 258:13 263:10 286:2 288:25 289:16 293:13,15 297:15,16 301:7 307:11 309:1 320:4 328:10 337:17 337:20 338:16,23,24 339:9 339:25 341:11 344:22 346:2 346:20 353:20 360:23</p> <p><b>analyze</b> 293:16</p> <p><b>anecdotal</b> 323:16,22</p> <p><b>animal</b> 324:17 338:14</p> <p><b>annual</b> 310:13 315:16,23 316:5 319:24 320:7</p> <p><b>annually</b> 303:10 313:23</p> <p><b>answer</b> 275:24 276:1 318:3,7 318:22,23 330:4,6 346:21 346:22 362:17</p> <p><b>answered</b> 275:22</p> <p><b>answering</b> 284:1 289:8 318:2 329:25</p> <p><b>answers</b> 351:18</p> <p><b>anticipate</b> 289:22,25</p> <p><b>anybody</b> 260:25 323:23 357:6</p> <p><b>anyway</b> 283:10</p> <p><b>apologize</b> 264:13 334:5</p> <p><b>Apparently</b> 315:19</p> <p><b>appear</b> 292:1 310:4 329:10</p> <p><b>appears</b> 286:7 309:1 328:18 369:15</p> <p><b>Appendix</b> 290:2,7,11,14,18 290:24,25 293:7,11 294:3 294:24 304:10 309:19 331:23 337:6 341:22 355:20 361:2,4 363:6</p> <p><b>application</b> 269:8 270:7,13 271:16,19 277:11 284:20 297:11,24 298:4 306:4 316:6 328:7,23 333:6 337:9 337:11 358:5 361:7,8 363:13</p> <p><b>applications</b> 268:9,21 269:14 328:21 345:4</p> <p><b>applied</b> 271:14,25 315:3 316:12 318:10,12 319:8 325:14,18,20 329:4,19,24</p>

334:1,10 335:10,24 338:13  
 341:8 343:12,22 347:15  
**apply** 259:7 260:18,23 263:6  
 263:9 269:21 270:17,22,22  
 271:10 277:9 300:16,21  
 306:23 334:16 338:8  
**approach** 258:12 285:24  
 293:21 296:15 315:8 337:24  
 340:8 363:1,10  
**approached** 360:22  
**approaches** 362:10,14  
**appropriate** 264:2 275:17  
**approved** 360:18  
**approximately** 305:18 306:7  
 313:4,14,15,22 316:11  
 317:12 318:13 324:16,21  
 329:1 330:2,11 333:5 356:4  
**approximation** 291:18  
 302:15 306:21  
**approximations** 293:17  
**AR** 255:15  
**area** 273:7,23 277:5 297:21  
 302:10 306:8 309:22 312:1  
 312:3 313:15,21 314:2,3,11  
 315:15 324:2 326:20,20,21  
 351:2,14,16 356:7 360:10  
**areas** 279:4 301:8 322:11,15  
 324:23 327:4,5 328:4  
**area-weighted** 360:12  
**arguing** 275:16  
**argument** 360:1  
**arid** 276:24  
**Arkansas** 261:11,12,18,19  
 262:8 263:7,12 264:12  
 267:3 273:2 304:4 305:3,8  
 305:12 309:10,16 312:20  
 313:21 314:3,4,7 315:1  
 343:19,23 345:16 352:1  
 353:13 357:9,24 366:16,19  
 367:4  
**arrived** 312:15 327:18 332:1  
 332:8,18,24  
**article** 279:8,9,11,14,17  
 280:4,8  
**aside** 309:10

**asked** 272:19 275:10 280:24  
 285:7,13,23,23 286:21  
 293:18 308:2  
**asking** 263:15 272:23,24  
 275:18 284:17 297:17,18  
**assembled** 304:16  
**assert** 301:15  
**assertions** 326:11,12  
**asserts** 347:5  
**assessed** 265:5 364:11,13  
**assessment** 259:18,19 262:11  
 284:12 291:13,17 341:2,15  
 358:23  
**assessments** 262:13 291:21  
 338:8  
**assume** 300:18 301:24,25  
 312:5 318:14 319:7,20  
 321:24 328:25 332:9 347:14  
 352:19 353:1,12 356:2,22  
**assumed** 297:24 314:12  
 322:13,19  
**assuming** 298:17 299:13  
 313:8,9 318:9 320:1,11  
 334:14 353:19 356:8  
**assumption** 284:24,25 285:22  
 286:1 291:17 296:6 298:1  
 299:4,6,12,18 306:10 320:6  
 320:25 321:12 322:1,19  
 323:18 335:9 338:11 339:2  
 339:3 344:23 351:13 355:10  
 355:15,17 356:11,12,12,13  
 356:14  
**assumptions** 285:13,14,16,19  
 285:21 291:12,21 292:3  
 295:19 297:16 298:19  
 300:11 301:1 302:16 327:12  
 327:16 335:14 337:19  
 338:25 339:1,4 340:4 341:2  
**assure** 343:21 347:22  
**attained** 259:9  
**attended** 367:2  
**attention** 283:10  
**attorney** 254:5 255:7,11,14  
 255:17 369:19  
**attorneys** 255:4 281:1,2,4,6

**attribute** 278:3  
**attributing** 350:25 351:1  
**audience** 281:22  
**Austin** 282:12  
**authors** 339:19  
**available** 265:19 296:24  
 302:14 303:11 304:5 312:17  
 316:5 324:8 328:13 337:10  
 338:12 343:23 361:8  
**average** 284:3 295:21 296:9  
 298:7,16 301:7,10 302:9,12  
 306:17,20,22 309:2,4 324:1  
 324:6,8 328:4 329:3,18  
 333:24 334:8 335:1,3  
 336:15 337:8 338:18 339:12  
 339:15,21 341:6 349:1,4,9  
 349:14 350:15,16  
**averages** 344:10 348:23  
 350:18  
**aware** 261:5 264:15 272:6,8  
 279:20 302:1 324:24 328:9  
 357:8 365:14  
**axis** 352:19,23 353:17 354:1  
**a.m** 257:2,5 292:12,14,15,17  
 331:16,18,19,21

---

**B**


---

**B** 259:25 260:14,23 261:2  
 309:7 311:24 313:9  
**back** 291:8 292:16 306:8  
 311:13 313:3 314:21 317:3  
 331:20 335:3 341:12 343:4  
 345:23 346:2 354:19,24  
 355:7 356:7 365:24 366:6  
**backwards** 315:2  
**bad** 265:16  
**badger** 275:17  
**badgering** 273:22  
**balance** 271:12 272:4  
**band** 317:18  
**bar** 354:2,4,5  
**based** 265:18 277:11 295:18  
 297:7 327:15 328:24 333:7  
 333:14 335:8 363:6 364:17  
**baseline** 297:9 328:11,16,25

<p>332:13 334:14 337:8 361:5  <b>basic</b> 284:19  <b>basically</b> 285:9,16 293:21  332:12,14 336:18 351:25  <b>basing</b> 277:10  <b>basis</b> 260:10,11 265:15 272:5  303:12 318:2,2 320:7,22  323:3,17 324:7 326:12  333:5 339:15  <b>Bates</b> 286:4,17 287:7  <b>bear</b> 295:14  <b>beef</b> 289:23 324:13  <b>began</b> 257:1 314:20  <b>beginning</b> 295:16,17 303:11  305:20 337:15  <b>begins</b> 313:13  <b>behalf</b> 254:16 261:23 367:14  <b>believe</b> 263:9 268:3 280:10  281:10 282:9,13 283:21  284:10 285:11 292:2,23  299:13 301:4,16,25 305:10  307:7 322:23 323:7 341:12  341:13 344:17 345:14  347:20 348:15 354:4 355:22  363:8 365:5,12 367:11  <b>benefit</b> 273:19 341:11  <b>Benton</b> 304:4 321:9 351:25  357:10  <b>best</b> 261:1 308:24 326:5  <b>better</b> 270:3  <b>beyond</b> 295:4 359:17,20  <b>big</b> 337:24 355:16,16  <b>bigger</b> 263:16  <b>Billy</b> 283:19 315:13 323:8  <b>biologist</b> 273:6  <b>bird</b> 304:16 310:13 316:19,25  317:24 318:4  <b>birds</b> 304:4 307:3,20,23  309:21 310:2,8 311:25  313:14,21 314:2,10 315:1  315:13,14,16,20 316:11  <b>blanks</b> 307:5 308:11,18  311:15  <b>blindly</b> 279:2,18  <b>blunders</b> 291:20</p>	<p><b>Bob</b> 257:8,19 275:9 333:9  367:16  <b>bodies</b> 324:24  <b>body</b> 281:22 355:11 364:11  <b>bold</b> 310:7  <b>books</b> 304:6  <b>border</b> 261:11,12  <b>Boston</b> 255:11  <b>bottom</b> 262:5 316:24 342:16  342:16 352:23  <b>boundary</b> 263:14,25 264:3,5  <b>Box</b> 255:18  <b>brain</b> 317:11  <b>branch</b> 303:15  <b>break</b> 281:12 292:9 294:12  365:18  <b>briefly</b> 277:18  <b>bring</b> 282:5  <b>broad</b> 272:10 291:3 300:15  361:15 362:25  <b>broilers</b> 312:19  <b>broke</b> 267:14  <b>brought</b> 317:16,17  <b>Bruce</b> 283:2  <b>brush</b> 291:3 361:15 362:25  <b>budgets</b> 289:16,23  <b>business</b> 336:3</p> <hr/> <p style="text-align: center;"><b>C</b></p> <hr/> <p><b>C</b> 254:6 255:1,14 257:14  309:19 316:3 317:4 318:9  369:1,1  <b>calcareous</b> 263:23  <b>calculate</b> 298:6 302:8,23  333:1  <b>calculated</b> 336:14  <b>calculation</b> 301:17 302:2  317:8 319:13,15 320:21  321:18 331:5  <b>calculations</b> 285:8,10 339:5  350:2  <b>calculator</b> 317:13,16,17  <b>calibrated</b> 277:14  <b>call</b> 284:10 294:18 335:20  361:23</p>	<p><b>called</b> 282:4 293:25  <b>calls</b> 281:5 282:24 283:12,15  <b>Cal-Maine</b> 255:17 257:19  <b>capacity</b> 254:5,7  <b>caption</b> 352:2  <b>care</b> 362:4  <b>career</b> 280:18  <b>Cargill</b> 255:6 257:16 282:21  <b>carry</b> 342:17  <b>cart</b> 339:17  <b>case</b> 262:17 273:24 283:22  287:17 289:1 299:17 307:16  307:19 308:23 310:17 351:9  357:15 367:8,9 369:11  <b>cases</b> 310:9 311:2,3,4 365:7  <b>cash</b> 338:9,9  <b>casual</b> 273:12,14 277:4  <b>catch</b> 290:22 317:11  <b>categorically</b> 301:15  <b>categories</b> 267:14,16,17,19  267:20,23 270:3  <b>category</b> 268:6 270:4,14,24  271:15 272:4 278:4,9,19  <b>cattle</b> 289:23 324:10,13,22  327:4,8,11  <b>cause</b> 254:17 368:7  <b>causing</b> 363:25  <b>census</b> 295:19,22 303:7 304:7  304:8 312:16 315:14,21  316:11  <b>central</b> 301:18 302:3,7  <b>certain</b> 263:20 264:3 265:4  285:12 307:4 326:11 337:19  350:1  <b>certainly</b> 289:10 300:11  323:21 337:21 358:22  <b>certainty</b> 321:25  <b>Certificate</b> 256:7  <b>certified</b> 254:20,21 369:6  <b>certify</b> 368:3 369:8,16,19  <b>chance</b> 289:9 290:4  <b>change</b> 263:22 281:15 288:7  292:8 331:13 342:2  <b>changed</b> 288:3,8 290:20  341:24</p>
---	--	--

**changes** 263:19 291:25  
 358:16,21 363:17  
**changing** 358:3,5,8,11,15  
**characteristic** 264:3  
**characteristics** 262:12,13  
 284:1  
**check** 311:12  
**checked** 319:15 322:8  
**checking** 271:21  
**chemical** 274:13  
**Cherokee** 303:10 321:8  
 354:25  
**chicken** 312:19 355:16  
**chickens** 303:9,18,21 305:7  
 310:13,19 312:2,18 355:5,7  
 355:8  
**choose** 310:23  
**circuit** 296:14  
**cite** 279:5 322:18  
**City** 254:18  
**classes** 273:9  
**Clay** 283:19,23 287:8,10  
 294:2,2 315:13,25 316:9  
 323:8,11,17,22 324:20,25  
 325:4  
**clear** 281:23,24  
**clearly** 281:14 314:9 353:25  
**clients** 308:10,14,16  
**close** 290:7 322:11  
**closed** 297:8 322:16 325:24  
 326:1  
**Coale** 254:15 256:4 257:4,21  
 258:2 260:8 266:17 272:3  
 272:11 273:25 280:11 283:4  
 286:5,17 287:5,23 288:16  
 289:14,21 291:4 292:7,22  
 293:3,5 294:15 295:12  
 297:23 304:6 305:2 318:20  
 320:25 326:19 331:22 337:5  
 341:6,20 342:3 357:8 358:2  
 360:3 364:17 365:13 366:1  
 367:12,19,22 368:3,12  
 370:1  
**Coast** 276:25  
**Code** 261:10,17

**colleague** 318:21  
**collected** 321:8,11 343:8  
 345:23 346:1,11  
**collecting** 346:15  
**collection** 351:11 360:14  
**College** 255:15  
**combine** 262:13  
**combined** 262:19  
**come** 306:2 319:13 351:18  
**comes** 312:12 325:23 366:8  
**comfort** 292:9  
**comfortable** 273:7 346:13  
 357:17  
**comment** 283:4 292:2  
**commercial** 328:19,20  
 346:19,20  
**Commission** 368:23  
**common** 262:5,7,10 322:9,20  
 322:23 355:15  
**commonly** 344:7 362:1  
**community** 279:1  
**company** 344:9  
**comparable** 344:4  
**compare** 260:9,15  
**comparing** 258:17 260:3,19  
 278:12 298:7  
**comparison** 290:6 337:3  
 342:1  
**completely** 350:18  
**compliance** 345:8,12,12  
**component** 363:5  
**components** 279:3,19  
**composed** 263:13  
**computations** 311:20 333:18  
**computer** 282:6  
**concentration** 265:25  
**concentrations** 276:15  
**concept** 275:1 276:8  
**concepts** 273:12,14 289:13  
**conceptual** 260:7  
**concerned** 345:16  
**conclude** 354:16,18 360:9  
**concludes** 367:21  
**concluding** 259:23 289:3  
**conclusion** 348:13 357:25

359:7 363:13  
**conclusions** 358:17  
**conduct** 258:12  
**conductivity** 364:10,13  
**conference** 281:5 282:2,6,8  
 282:23 283:14,23 294:18  
 366:21  
**conferences** 281:20 282:18  
 282:20 283:5 357:20  
**confidence** 336:19,22  
**confident** 353:23  
**confidential** 292:21  
**confidentiality** 292:23  
**confirm** 292:21  
**confusing** 329:15  
**consensus** 279:2  
**consequently** 312:5 319:17  
 320:3  
**conservative** 330:8  
**consider** 259:12 262:25  
 264:23 294:10 329:18 358:8  
 358:16,24,25 359:8  
**considered** 264:12 358:20  
 359:13 367:11  
**considering** 320:15  
**constant** 310:20 314:13  
 315:15 319:22 320:1  
**constitutes** 363:14  
**consultant** 305:16 316:8,9  
 328:8  
**consultants** 291:2 295:20  
 296:6  
**consultation** 323:8 366:11,14  
**consultations** 367:3  
**contain** 369:17  
**contained** 349:4  
**content** 306:16  
**context** 299:20,21 330:7  
**continue** 359:21  
**continued** 256:5 257:25  
 292:14 331:18 365:22  
**contracted** 343:13  
**contrary** 351:5  
**controlled** 345:7  
**conventional** 276:8



**conversation** 283:18,19,20  
 284:7,16 339:20 340:2  
 363:3  
**conversion** 267:25 269:2  
**copies** 286:25 287:4  
**copy** 279:13 342:3  
**corn** 303:17  
**correct** 258:23 259:23 260:2  
 260:4 262:21 264:22 265:9  
 266:25 268:10,12,15,23  
 269:11 270:6 271:23 278:1  
 278:13,21 290:12,16 293:4  
 294:19 296:4,12 297:22  
 298:18 302:25 307:18  
 311:10 312:7 313:8 314:4  
 325:8 327:22 336:12 343:1  
 343:2,25 345:21 347:11  
 349:2 357:3 359:5 360:8  
 362:12 364:16 368:5,7  
 369:17  
**CORRECTION** 370:3  
**CORRECTIONS** 370:1  
**correctly** 258:18 264:24  
 265:22 266:17 268:9 269:17  
 278:10 351:24 352:5 355:18  
 360:14  
**correctness** 291:9 305:21  
 327:11  
**correspondence** 294:20,21  
**corresponds** 351:15  
**cost** 341:11  
**counsel** 257:6 287:4 318:21  
**count** 353:24  
**counties** 304:4 309:9,10,16  
 309:16 310:14 311:11,17  
 312:20,21 313:6 321:9,10  
 354:24 356:8 357:10,11  
**country** 303:16,20  
**county** 254:18 303:16,20  
 304:13,15,17,21,25 309:11  
 351:25 369:4,7  
**couple** 281:19 283:13,14  
 286:4 295:13  
**course** 306:12  
**court** 254:1 328:10,14 363:4

**cover** 356:5  
**covered** 293:3  
**cow** 326:8  
**cows** 303:18  
**create** 275:13 310:12,24  
 315:6,22  
**created** 321:22  
**critical** 279:4 348:16  
**criticized** 342:24 350:11  
**crop** 266:23,23 270:11,23  
 271:7,8 277:13 284:21  
**crops** 366:5  
**cross** 264:3,5  
**CRR** 369:24  
**CSR** 369:24  
**current** 290:25 295:21  
 305:15 315:12 336:16  
 341:14  
**currently** 301:16  
**cut** 281:11  
**cycle** 270:20,23

---

**D**


---

**D** 256:1 258:9 287:20  
**danger** 363:24  
**data** 262:22 265:18 268:18  
 268:19 269:23 277:5 295:18  
 295:19,23 296:5,23 301:16  
 301:22,24,25 302:1,14  
 303:8 304:3,3 307:3,4 308:6  
 308:7,10,12,24 310:9,10,12  
 310:13,17,23,25 311:12,13  
 312:16 314:12,22 315:7  
 321:8,11,15,22,23,23 335:7  
 335:13 337:2 342:25 343:5  
 343:9,10,15,16,17,23 344:1  
 344:3,5,13,15,18,24 345:9  
 345:20,23,25 346:5,15  
 348:7 349:6,22 351:11  
 352:1 353:9,13,20 356:19  
 360:13 362:3,8 364:23  
**databases** 345:3  
**dataset** 265:20 345:7 349:21  
 350:1  
**datasets** 342:18,20 343:4,7  
 345:5 349:17 350:19  
**David** 255:3 257:10 359:25  
**day** 254:17 359:16 368:8,18  
 369:22  
**deal** 273:13  
**dealt** 358:10  
**deceptive** 348:9,19,21  
**decided** 312:23  
**decision** 265:8 276:10  
**decisions** 300:16 346:4,9,12  
 346:15,21  
**decrease** 273:17 274:3  
**decreased** 272:13  
**deemed** 328:10 340:9  
**deeply** 267:8  
**defecation** 324:22  
**defendant** 305:25  
**defendants** 254:12 257:15,17  
 257:20 261:24 272:19  
 305:17 307:16,19 316:9  
**defensible** 363:10  
**deficiencies** 343:6  
**defined** 267:2  
**defines** 345:11  
**degree** 364:10,13  
**Delaware** 303:10 321:8  
 354:25  
**demand** 270:11 320:8  
**demands** 335:1  
**demonstrate** 263:3  
**dependent** 271:2 327:12  
 363:16  
**depends** 259:11 263:14  
 276:22 311:2,4 345:11  
**deposited** 274:14,19  
**deposition** 254:15 257:1,4  
 359:15 367:10,22 368:4  
 369:12,18 370:1  
**depositions** 359:22  
**derive** 302:14  
**describe** 326:16  
**describes** 302:9  
**descriptive** 284:4  
**designed** 364:6  
**designing** 291:5



**detail** 314:19 318:18 358:7  
**determination** 330:9  
**determine** 303:19 310:1  
**determined** 321:6 357:9  
**determining** 301:7 303:1  
 315:15  
**develop** 291:13 293:20  
**developed** 295:20 306:4  
**development** 288:15 324:13  
**devoid** 350:18  
**Dicks** 283:20 284:8 285:1  
 286:8,21 287:11,13,16,24  
 289:16 291:12,25 292:20  
 293:11,25 294:7,9,10,11  
 295:1,23 297:24 300:4  
 304:9 305:3 307:15 314:17  
 339:13 342:12,24 346:25  
 351:21 352:5 355:19 358:4  
 359:3 360:6,16 361:21,24  
 362:13  
**diesel** 341:14  
**differ** 268:17  
**difference** 264:7 337:24  
 340:11  
**differences** 278:6  
**different** 266:3 268:9 275:10  
 282:10 288:20,22 290:15,19  
 350:20 360:25 362:6,7,7  
**difficult** 276:16  
**difficulty** 283:16  
**diminish** 275:5,6  
**direct** 256:5 257:25 308:7  
**directly** 322:12 324:10  
**disagree** 348:12,19  
**disagreement** 303:4  
**discuss** 300:3  
**discussed** 289:19,23 314:16  
**discussing** 280:8  
**discussion** 266:15 289:13  
 292:19 300:17,23 358:20  
**dismiss** 300:19  
**dispute** 301:21  
**distance** 334:18 341:16  
**distinguish** 285:20  
**distributed** 298:22

**distribution** 263:10 298:20  
 356:17  
**DISTRICT** 254:1,2  
**divided** 351:2  
**document** 282:5,7 283:15  
 285:17 286:10,15,19 287:6  
 287:10,11,12,16 290:8  
**documented** 274:16,20  
**documents** 286:4 287:8,14,19  
**doing** 261:5 283:16 284:11  
 289:25 293:11 337:17  
 338:10 342:1 361:25 362:2  
 362:4 364:11  
**dollars** 338:9  
**double** 266:18 356:12  
**doubt** 298:24 299:1  
**Dr** 257:4 258:2 260:7 266:17  
 272:2,10 273:25 280:11  
 283:4,23 284:8 285:1 286:7  
 286:21 287:5,13,16,23  
 288:16 289:14,16,21 291:3  
 291:12,25 292:7,22 293:5  
 293:11,25 294:2,2,7,7,9,9  
 294:10,15,15,21 295:3,12  
 295:23,23 297:23 300:3,4  
 304:6 305:2 307:15 314:17  
 315:25 316:8,9 318:20  
 320:25 322:24 323:11,16,22  
 324:25 325:4 326:19 328:8  
 328:10,16,18 330:14 331:22  
 337:5 341:5,20 342:3,24  
 343:6,23 344:4,18 346:5  
 347:5,10 348:6 349:4,23  
 350:11 351:21 352:1 357:8  
 358:2,4,15,23 359:16 360:3  
 361:20,24 362:2,9 363:12  
 364:17 365:13 366:1 367:12  
 367:19  
**draft** 281:11 285:13 286:8  
 287:25 288:3 291:24 341:24  
 342:11  
**drafts** 281:16,20  
**dramatically** 263:22  
**draw** 263:14 310:19  
**drawn** 269:18

**DREW** 254:4  
**drop** 316:13  
**drops** 312:10 319:10 328:9  
 328:24  
**dry** 276:23  
**due** 365:6  
**duly** 254:20 257:22 369:9  
**dynamic** 276:15  
**dynamics** 285:15

---

**E**

---

**E** 255:1,1 256:1,3,3 288:18  
 288:20 290:10 342:4 359:2  
 359:12 360:5 369:1,1  
**earlier** 276:3 286:9,22 323:7  
 330:25 360:22  
**early** 312:17  
**East** 276:25  
**Eco** 308:4  
**ecological** 274:16,21  
**economic** 284:11 286:2  
 289:15 291:13 293:13,22  
 297:15 300:16 301:6 308:21  
 335:18 337:3,17,20 338:8  
 338:15,22,24 339:8,25  
 340:9,13 360:23 361:15  
 362:1,25  
**economics** 291:16 297:18  
**economist** 300:18 341:10  
**economists** 285:14 291:14  
 300:14 323:4  
**edit** 281:18  
**edited** 281:17  
**EDMONDSON** 254:4  
**effect** 266:5 358:16  
**effective** 318:11  
**efficiency** 330:4 332:6  
**effort** 264:15  
**either** 261:10,17,24 263:12  
 263:17 271:18 279:2,17,19  
 283:3,5 291:7 305:25  
 314:17 323:4 329:25 332:18  
 332:24 345:15 362:15  
 366:19 369:20  
**elevated** 365:6

<b>embedded</b> 289:12 <b>embrace</b> 263:11 <b>empirical</b> 265:15 325:1 <b>employees</b> 367:4 <b>employment</b> 365:15 <b>enable</b> 301:17 302:2 <b>ended</b> 349:9 <b>endorse</b> 323:22 <b>endorsed</b> 339:12 <b>ensure</b> 330:9 332:5,15 333:22 334:2 347:20 363:21 <b>ensures</b> 328:3 <b>enterprises</b> 335:14 336:11 <b>entire</b> 314:13,14 332:5,10 339:14 343:1 351:2 <b>environment</b> 254:6 358:3,9 358:11,15,21 359:9 <b>environmental</b> 264:16 265:2 265:10 267:4,11 268:14 273:9,14 303:25 364:19 365:2 <b>environments</b> 276:24 <b>equal</b> 350:12 <b>equates</b> 269:19 <b>equation</b> 313:1 <b>erroneous</b> 350:13 <b>error</b> 350:4,5 <b>errors</b> 343:5 <b>essential</b> 307:11 <b>essentially</b> 281:11 <b>establish</b> 264:16 <b>established</b> 265:2 305:10 333:2,20 348:16 <b>estimate</b> 258:16 259:15 284:23,24 285:4 295:21 296:21 297:5 298:16 303:2 305:14 306:3,25 312:18 314:10,25 317:1 320:4 321:15 322:5 327:15 328:6 328:12 329:23 330:8,13 336:19,22 337:6 338:1 361:4 <b>estimated</b> 316:12 323:25 324:6 331:25 335:1 <b>estimates</b> 285:2 305:16,18	316:5,7 317:4 321:21 <b>estimating</b> 310:7 311:25 316:3 321:7 340:14,14 362:10,14 <b>estimation</b> 308:4 311:3,4 335:8 336:13 360:10 <b>et</b> 254:11 279:5 <b>Eucha-Spavinaw</b> 343:8 <b>evaluate</b> 364:7 <b>evaluated</b> 296:15 <b>evaluation</b> 259:13 262:14 335:18,19 337:1,23 339:23 340:7,9 360:24 361:15 362:1,3,25 363:9 364:12 <b>event</b> 369:21 <b>events</b> 282:16 283:18,19 <b>evidently</b> 343:17 <b>exactly</b> 260:6 266:13 299:15 <b>Examination</b> 256:5 257:25 <b>examining</b> 292:22 <b>example</b> 263:20 276:10 <b>exceeded</b> 268:21 <b>exceeding</b> 349:11 <b>excess</b> 258:25 343:21 353:14 353:21 354:15,17 <b>excessive</b> 267:16,18 356:2 <b>exclude</b> 294:9 312:21 <b>excrement</b> 355:10 <b>excuse</b> 286:5 287:11 290:18 319:1 322:18 332:16 360:10 <b>exempt</b> 359:6 <b>exercise</b> 338:3,6 <b>exhibit</b> 258:5 280:5 287:6,15 288:17,19,23 289:5,24 290:13,15,17,18 291:24 293:5,7 341:21,23 342:8 355:4,20 359:4 361:2 <b>exhibits</b> 287:23 288:11 293:3 <b>exist</b> 262:8 <b>existed</b> 272:7 <b>existence</b> 302:1 <b>exists</b> 272:3 301:17 302:1 <b>expect</b> 266:9 271:18,24 272:11 273:18 274:3 275:6 277:5 299:2,10 300:1	326:24 327:2 335:25 355:11 356:16 <b>expected</b> 271:7 277:11,12 <b>experience</b> 282:3 <b>expert</b> 275:12,19 280:17 283:11 285:12 287:20 294:1 305:18,24 319:12 <b>expertise</b> 291:16 293:19 364:18,24 <b>experts</b> 283:4,22 307:16 359:23 <b>Expires</b> 368:23 <b>explain</b> 271:4 277:7 288:18 313:23 320:21 352:22 <b>export</b> 319:1 <b>exportation</b> 305:19 318:10 <b>express</b> 261:9,16 <b>expressed</b> 340:21 <b>expressing</b> 363:18 <b>Extension</b> 347:19 <b>extension-type</b> 366:18,22 <b>extent</b> 261:10,17 311:22 357:1 363:2 <b>extra</b> 287:2 <b>extracted</b> 342:11 <b>extrapolate</b> 309:8 <b>extrapolation</b> 309:20 <b>extrapolations</b> 307:2 310:5 <b>extremely</b> 350:24,25 <b>E-mail</b> 294:20 <b>e.g</b> 310:10
<b>F</b>		
		<b>F</b> 369:1 <b>fact</b> 278:3 292:20 309:11 336:2 <b>factor</b> 268:3 302:10 315:15 <b>factors</b> 259:12 264:1 320:8 <b>failure</b> 350:16 358:16 <b>fair</b> 291:17,17,18,20,21 336:9 339:3 352:8 353:4 356:22 <b>fairly</b> 346:14 <b>false</b> 349:1 <b>familiar</b> 289:2 342:7 <b>far</b> 286:13 292:22 294:13

<p>314:21 341:6,12 345:15 347:10 <b>farm</b> 258:15 259:5 284:3 289:16 363:17,20 <b>farmer</b> 260:17,22 <b>farmers</b> 345:10 366:11,15,23 <b>farming</b> 284:5 289:13 <b>Farms</b> 255:10 257:13 <b>Fayetteville</b> 255:15 366:21 <b>fed</b> 366:6 <b>feed</b> 327:5 <b>feedback</b> 281:20 <b>feeding</b> 322:11,13 327:10 <b>feel</b> 273:7 <b>fertilizable</b> 296:10 301:8 324:2 327:9,17 330:20 332:22 335:10 <b>fertilizer</b> 284:20 328:20,20 329:4,19,24 330:22 350:8 366:5 <b>fescue</b> 325:24 <b>fewer</b> 278:8,15 <b>field</b> 258:15,22 259:5,8,24,24 259:25 260:5,10,13,13,23 260:23 261:2 271:9 272:7 276:19 324:11 325:10 326:7 328:4,22 330:4,10 332:5,10 341:5 344:14 347:6,16,21 360:12 361:12 364:8,10,15 <b>fields</b> 258:17 259:24 260:3,9 260:12,15,25 265:4 322:10 322:12,14 324:10 325:23 327:9 328:19 346:6,9,14 <b>fifth</b> 275:15 <b>fifty-one</b> 312:11 <b>figure</b> 268:7,16,17,17,19 271:4 277:18,20 278:4,5 279:6 296:11 311:6 318:4 318:19 320:18 325:5 332:8 351:20 352:6 353:14,15,21 354:6,20,23 <b>figures</b> 267:13 <b>filing</b> 328:13 <b>fill</b> 307:5 308:10,18 311:15 315:7,22</p>	<p><b>final</b> 287:24 288:3 290:14 292:1 342:4,11 348:13 358:2 <b>find</b> 276:6 301:14 308:7,10 364:14 <b>finding</b> 345:8 <b>fine</b> 311:3 335:19 337:21,25 361:16 <b>first</b> 257:22 281:10,10,11 282:3 286:16 287:5 288:19 288:23 289:5,24 290:23 296:23 297:2 329:5 330:23 342:17 348:14 352:8 355:24 369:9 <b>firsthand</b> 321:17 <b>Fisher</b> 316:8 <b>fit</b> 267:15,22 <b>five</b> 356:7 <b>five-county</b> 309:22 312:1,2 313:15,21 314:11 315:15 356:6 <b>five-year</b> 303:12 <b>fix</b> 287:17 <b>flat</b> 299:24 300:20 <b>flaw</b> 351:18 <b>flip</b> 290:1 <b>follow</b> 314:8 360:25 <b>following</b> 292:13 302:16 331:17 365:21 <b>follows</b> 257:24 <b>FOODS</b> 254:11 <b>footnote</b> 312:10,14 316:13,23 316:24,24 317:7 318:4 319:10,20 326:10,13,14 328:9,24 329:2,12,13,13 <b>footnotes</b> 355:22 <b>forage</b> 266:22 277:15 289:23 295:21 297:7 320:10,16,23 323:25 324:5,9,14,17 325:23 326:7,19 327:4 330:21 331:24 332:23 333:8 333:15 337:7 338:14 340:17 361:5 <b>forages</b> 284:20 <b>forage-producing</b> 296:10</p>	<p>301:8 335:11 356:5 <b>foregoing</b> 368:4 369:16 <b>form</b> 259:2 261:3,7,14,21 262:2 263:2,8 272:14,19 273:22 277:7 285:13 287:9 289:12,19 291:10 292:1 299:20 304:23 307:10,21 311:1,9 323:6,14,19 325:16 335:5 337:13 339:16 340:5 340:20 341:24 344:6 345:17 346:8,17 347:12 352:14 353:7 355:9,21 357:16 358:18 359:12,17 360:20 361:22 363:7 364:22 365:4 369:14 <b>format</b> 281:8,13 <b>formulate</b> 293:15 <b>forward</b> 340:11 <b>found</b> 279:8,9 341:13,15 364:25 <b>four</b> 343:7 354:24 <b>frame</b> 276:17 <b>Frank</b> 254:15 256:4 257:4,21 367:22 368:3,12 370:1 <b>frequent</b> 291:15 <b>front</b> 258:5 291:4 293:8 <b>full</b> 311:22 355:24 369:17 <b>fundamental</b> 263:25 <b>further</b> 366:2 369:16,19 <b>future</b> 276:13</p> <hr/> <p style="text-align: center;"><b>G</b></p> <hr/> <p><b>G</b> 256:3 <b>gathered</b> 352:1 356:19 <b>gathering</b> 344:13 <b>general</b> 254:5 281:22 283:25 284:25 297:14 305:13 320:6 326:3,5 338:13,15,17 345:25 <b>generalities</b> 337:19 <b>generalization</b> 293:16 <b>generalizations</b> 300:15 <b>generalize</b> 301:4 <b>generally</b> 272:25 <b>generate</b> 285:1</p>
--	--	---

**generated** 266:8 285:5,6  
 303:20 331:3 341:7  
**generation** 318:1 337:7  
 340:15,17 361:4  
**generic** 299:22  
**George** 282:17  
**George's** 255:14 257:14  
 343:14  
**getting** 339:17 347:24,25  
 353:22,24 364:15  
**gist** 284:16  
**give** 262:14 289:8 290:4  
 326:5 349:1  
**given** 290:25 297:13 306:6  
 316:12 322:3 330:8  
**gives** 330:6  
**giving** 350:11 359:21  
**gleaned** 284:7 350:1  
**go** 259:17 270:2 273:6 287:3  
 288:9,11 292:18 296:18  
 301:14 304:6,7 307:25  
 313:3 317:3,19 327:13  
 335:7 340:11 343:4 345:23  
 352:19,20 360:1  
**goal** 277:12 311:5 337:25  
 363:15  
**goals** 362:7 363:21  
**goes** 264:21 311:13 326:11  
 347:10 352:20  
**going** 259:12 260:23 266:19  
 274:25 277:13,15,16 284:14  
 285:24 288:9,11 289:4  
 290:2 292:22 295:1,15  
 301:21 304:19,21 306:12,14  
 308:16 310:3 311:5 314:24  
 323:9 336:25 339:5 349:22  
 351:11,13 354:20 356:9  
 359:6,14,21,25 360:24  
 361:1 362:25 363:8  
**good** 258:2,3 268:2 286:1  
 308:21 321:4 340:22  
**Gordon** 342:20 363:12  
**grain** 366:5  
**grammatical** 288:5  
**graph** 315:7 352:5,9,17

**graphs** 311:20  
**grass** 277:15 363:14  
**graze** 326:8 327:4  
**grazed** 326:1  
**grazing** 327:11  
**greater** 265:25  
**greatest** 354:9  
**gross** 311:4  
**grossly** 301:4 351:4  
**group** 260:11  
**grow** 277:15 326:6  
**growers** 366:23  
**growth** 266:23 277:13 314:6  
 325:25  
**guess** 258:9 262:4 278:8  
 294:1 295:4,6 296:19 297:1  
 301:21 307:4 308:19 310:3  
 334:16,21 345:11 350:14  
 358:7

---

## H

---

**hair** 353:1  
**half** 267:25 268:3,5 278:18  
 354:16 359:19  
**hand** 286:6 287:5 288:16  
 307:9 368:8 369:22  
**handled** 298:3  
**hands** 308:24  
**Hang** 320:19  
**happen** 265:16,17 350:23  
**happens** 342:3  
**hard** 361:23,24  
**harder** 361:20  
**harvest** 271:9 326:7  
**harvested** 271:7,8,8  
**hash** 352:24 353:11,16  
**hay** 320:11 321:5,7,15,15  
 322:3,7,10,14 323:12 324:1  
 324:6 326:8 338:14 356:6  
**headed** 302:23  
**heading** 311:24 343:5 346:25  
 348:14 358:3  
**heads** 367:15  
**hearing** 265:22 279:10 280:9  
 367:24

**heavy** 276:25  
**height** 354:4  
**held** 266:15 314:12  
**help** 279:6 281:18 287:17  
 294:2 302:6  
**helping** 357:19  
**hesitating** 270:20 308:19  
**high** 264:23 270:24 271:15  
 272:4,9 278:15,19 349:16  
 350:24,25  
**higher** 259:20,21 260:1 266:7  
 266:9  
**highlighted** 288:9  
**Hill** 255:6 257:16,16  
**hilly** 299:24  
**hired** 307:25 308:1  
**historical** 291:1 297:7 298:7  
 303:3  
**historically** 302:24 307:24  
**history** 297:10 360:13  
**hold** 289:7  
**holding** 273:1  
**hope** 270:17  
**hopefully** 274:8  
**horse** 339:17  
**hosted** 282:4  
**hours** 359:18,19  
**hundred** 259:20 312:11

---

## I

---

**idea** 307:22 322:25 355:6  
**identify** 257:6 279:3  
**ignore** 279:2,19  
**II** 254:14 257:4 370:2  
**Illinois** 261:6,13,19 263:16  
 269:4,15 272:12 273:18  
 274:4 275:5,8,14 277:2  
 298:23 299:6 301:2 319:1,5  
 321:2 322:20 323:13 329:3  
 335:23 341:18 365:9  
**imagine** 366:20  
**impact** 274:16,21,22,25  
**implementation** 363:17  
**implemented** 358:6  
**implicated** 292:24 365:7,10

**import** 318:25  
**importance** 274:9  
**important** 274:17 329:8  
**imported** 319:4  
**impression** 288:4,6 349:1  
**improper** 347:1 359:18  
**improve** 272:12  
**improved** 261:19 365:15  
**improvement** 261:25  
**inappropriate** 275:12  
**inch** 347:21  
**include** 307:2 312:23 316:7  
**included** 293:1 305:1,20  
349:15  
**includes** 268:13 277:20  
**including** 312:9,11 324:23  
**incomplete** 308:6  
**incorporate** 262:11  
**increase** 271:19 272:1 298:9  
314:2 326:20,25 333:4  
**increased** 313:22  
**independent** 305:21  
**independently** 352:7  
**index** 258:12,20 259:6,7,13  
259:18,24,25 260:8,19  
261:12,18 262:19 263:1,9  
264:1,6,21 265:6 267:7,10  
267:15,19 268:20 269:22  
270:9 272:2 363:23 364:2,4  
364:5,6,12 365:15  
**indicate** 336:14 352:17  
**indicated** 352:20 355:22  
**indication** 308:9,14,15  
**indices** 262:1,6,9 280:6  
**individual** 283:21 288:5  
351:16  
**individuals** 337:16  
**industrial** 274:13  
**industry** 305:10 308:7  
**information** 275:24 276:12  
293:1 312:15 323:16 326:17  
338:8 357:13  
**initial** 290:21  
**injunction** 279:10 280:9  
**injury** 364:3

**inputs** 272:4  
**inserted** 333:13  
**instances** 281:19  
**insubstantial** 333:16  
**integrator** 344:9  
**integrators** 343:14  
**interested** 274:10,12 369:21  
**interpolate** 308:22  
**interpolating** 308:18 311:14  
**interpolation** 310:11,15  
**interpolations** 314:5  
**interpret** 299:23 316:18  
324:15  
**interpretation** 280:1 299:22  
309:25 311:18 313:2  
**interpreted** 259:21 361:24  
362:2  
**interpreting** 324:4  
**inventory** 309:22 312:2  
315:14,16,23 316:11  
**involved** 291:4,7 350:5,17  
**IRW** 284:1 293:14 295:22  
296:11,22 297:10 300:8  
303:2,3 309:23 315:13  
316:6 322:9 328:12 330:21  
333:8 335:10,14 336:11  
337:11,18 356:1 358:6  
360:11 361:8 362:11,15  
363:14 366:12  
**issue** 292:24 333:16  
**i.e** 258:13

---

## J

---

**Jackson** 255:19  
**January** 254:18 257:5 369:23  
**job** 304:19 307:9  
**John** 282:25  
**Johnson** 343:6,24 344:4,18  
346:5 347:5,10 349:4,24  
350:11 351:22 352:1 358:4  
361:20 362:2,9  
**Johnson's** 330:15 342:20,25  
348:6 358:15,23 363:12  
**joint** 294:25  
**Jones** 283:2

**Jorgensen** 282:14,15  
**judgments** 293:17  
**justified** 363:12

---

## K

---

**K** 255:14 257:14  
**keep** 271:11,13 331:14  
**kilogram** 268:22 277:22  
278:9 329:14,22,22  
**kind** 284:21,25 295:14,16  
297:15,16 344:3,4,14,24  
345:9 346:6  
**know** 261:4,23 263:24 267:5  
267:6 272:20 274:18,23,24  
276:6 277:3 280:23 281:23  
282:9,21,22,22 284:2,21  
285:24 287:10 288:2 290:21  
293:25 294:4,16 295:22  
296:3,5,13,16 297:23 298:1  
298:3,24 299:15 303:23  
304:24 305:2 306:2 307:19  
307:23 308:12,19,25 309:14  
309:17 310:1 312:3,5,10,21  
313:6,17 314:13 315:4,25  
316:14,16 318:23,25 319:4  
319:6,12,16,25 320:16  
321:11,25 322:19 323:2,11  
323:15,20 325:3,4,6,9 326:2  
326:12,17 327:18 328:14  
329:5,8 330:23 331:3,3  
332:1,7,18,20,23 335:16,20  
338:10 339:24 344:8 345:18  
345:24 349:3,8,14,20 351:3  
351:14 355:3 356:21 357:1  
357:6,7,7 367:6  
**knowing** 274:9 279:25  
355:15  
**knowledge** 262:3 263:19  
295:5 305:21 315:5 321:18  
322:22 323:9 349:10 364:18  
**known** 283:9  
**knows** 323:4

---

## L

---

**L** 261:2



**lab** 267:20,22 344:14 346:2  
 346:19,23  
**labeled** 286:4  
**laboratory** 350:4  
**lacking** 302:13  
**land** 259:4 269:10 273:17  
 297:10 298:3 299:13,14,15  
 299:18,23,24,24,25 300:1  
 302:10 306:4 316:6,12  
 318:10,11 319:8 333:6  
 334:1,10 337:11 343:13  
 346:4 351:2,14 361:8  
**landscape** 263:4,7,10,21,24  
 264:4 274:15,18 351:8  
**large** 263:24 345:3  
**larger** 351:14  
**launch** 292:7  
**Law** 255:4,7,11,14,17  
**laws** 254:21  
**lawsuit** 367:5  
**lawyer** 280:12,13 281:18  
 283:12  
**lawyers** 282:12,14  
**lay** 338:24  
**layers** 312:20  
**leave** 326:8  
**leaves** 327:7  
**leaving** 364:15  
**led** 322:22  
**left** 326:25 334:4 355:4,19  
**legal** 265:7  
**legitimate** 315:8  
**let's** 258:8 268:7,16 270:2  
 273:13 277:18 289:21 290:1  
 293:5 296:18 298:19 309:12  
 316:23 317:10 331:13 340:1  
 340:11 342:15 343:4 350:21  
 351:19 360:2,3 365:18  
**level** 265:4,20 266:7 273:13  
 274:2,25 275:2 278:14  
 293:10 297:9 308:20 314:18  
 322:3 328:1 332:4,5 338:22  
 347:23 348:15,16 350:23,24  
 351:1  
**levels** 261:13 274:1,4 278:7

290:25 334:25 365:6  
**light** 288:14  
**lighter** 361:25  
**limit** 264:12,18,24 265:1,17  
 265:18,23 266:6,18 267:1  
 267:11 269:6,7 326:1 347:8  
 347:13 348:3 353:12  
**limitation** 269:18  
**limited** 269:3 271:2 277:6  
 348:3  
**limits** 264:10  
**limnologist** 273:5  
**line** 266:11 281:6,7 370:3  
**linear** 310:11,14,20,21 314:5  
**linearly** 311:14  
**Lisa** 254:19 367:20 368:5  
 369:6,24  
**list** 355:2  
**listening** 318:20  
**literal** 293:6  
**Literature** 291:2  
**litter** 259:7 260:18,23 261:2  
 269:25 270:7 271:14,19,25  
 291:1 296:22 297:10 298:20  
 298:22 302:24 303:3 305:15  
 305:19 306:4,6,8,11,16,23  
 306:23,25 309:23 310:2  
 316:4,5,10,12,19,25 317:1,5  
 317:24 318:9,12 319:4,8,9  
 319:21,23 320:8,13,15  
 321:1,7,20 325:14,14,17  
 328:7,20,22,23 329:1  
 332:17 333:2,4,6,7,14,21,24  
 333:25 334:8,9,12,16 335:9  
 335:11,22 336:6 337:7,9,10  
 338:11 340:14,14,17 341:6  
 341:12 343:13,21 356:1,4  
 356:10,17,20,24 358:5,9  
 361:4,6,7 363:14 364:20  
 365:3 366:1,2  
**little** 270:3 288:12 290:15  
 296:2 297:1 320:19  
**live** 322:24  
**lives** 323:1  
**livestock** 300:6,7

**load** 258:13  
**loafing** 350:23  
**located** 313:5,16  
**logic** 285:8 291:21  
**long** 281:12 340:10  
**look** 258:8 260:23 268:7,16  
 277:18 284:3 288:23 289:2  
 289:9 290:4 307:12 308:3  
 318:1 339:1 342:5,15 343:4  
 343:9,14 344:1,5,7,15 345:3  
 345:5 351:19 358:9 360:2,3  
**looked** 279:7 281:20 286:13  
 287:8,16 288:20,24 292:3,5  
 295:24 296:7 305:24 318:3  
 341:9,11,24 343:24 344:4,8  
 344:18 346:6 348:6 355:19  
 367:8  
**looking** 260:25 270:16  
 278:24 293:5 302:12 314:1  
 339:14 347:18  
**looks** 286:20 288:22 290:6,13  
 301:5 311:11 315:3  
**loss** 258:17,24 259:3,16,22  
**losses** 279:4 280:7  
**lot** 280:24 305:7 306:12,16  
 326:6 335:6 336:19 338:25  
 349:22 361:20  
**lots** 322:12,13  
**low** 267:16,17 270:3,8 271:18  
 278:4 351:7  
**lower** 275:20,20 278:14

---

**M**


---

**M** 261:2  
**Maguire** 279:5,7,12,17  
**Maguire's** 279:22  
**mail** 294:21  
**main** 313:4  
**major** 302:22  
**majority** 353:5,9  
**making** 276:9  
**man** 317:25  
**manage** 306:14  
**managed** 259:4  
**management** 276:10,12,18



<p>327:11 345:9 346:3,9,12,15 346:21 360:13 363:17,20 <b>managing</b> 306:17 <b>mark</b> 287:3 352:24 353:11,16 <b>marked</b> 287:6,15 288:16 292:20 342:7 <b>marking</b> 341:20 <b>Maryland</b> 262:9,20 263:1 264:10,20 267:9,10,14 268:11 269:24 270:8 273:15 274:3 315:10 341:10 344:5 344:15 <b>materially</b> 288:3 <b>math</b> 271:22,23 314:1 318:15 318:17 320:19 322:8 331:11 332:20 <b>mathematical</b> 302:15 <b>matter</b> 289:6 294:22 308:13 <b>matters</b> 362:22 <b>McDaniel</b> 255:10 257:12,12 259:2 261:3,7,14,21 262:2 263:2,8 271:20 272:14 273:3,21 274:6 275:9,22 281:3,8 282:9 286:3,16 287:2 288:4 289:7,11 292:25 294:6 295:7,10 298:13 299:19 304:23 307:10,21 311:1,9 317:15 323:6,14,19 325:16 327:20 333:9,12,16 334:4,6 335:5 337:13 339:16 340:5,20 344:6 345:17 346:8,10,17 347:12 352:14,18 353:7 355:9,21 357:16 358:18 359:11,24 360:20 361:22 363:7 364:22 365:4 367:14 367:19 <b>mean</b> 259:16 282:1 287:10 294:11 299:23,23 302:7 309:24 311:19 315:18 317:2 324:3,13 334:3,24 336:17 339:13,18 354:7,11,14 <b>meaning</b> 350:20 <b>means</b> 267:1 299:16 302:8,11 309:17 312:22 313:19,24</p>	<p>321:24 324:4 325:10,13 326:2,3 334:13,19,23 348:23 351:13 <b>meant</b> 260:10 287:12 300:1 326:16 <b>measure</b> 302:15 310:19 336:15 <b>median</b> 301:7,9 336:15 354:6 354:12,13,13,15 <b>medium</b> 267:16,17 268:6 270:13,16 271:18 278:9 <b>meet</b> 356:2 <b>memory</b> 341:13 <b>mental</b> 284:5 <b>mentioned</b> 285:11 304:18 342:14 <b>mentions</b> 294:1 <b>mess</b> 294:13 <b>message</b> 281:24,24 <b>method</b> 297:14 298:11 308:17 310:12 339:12 <b>methodology</b> 291:5,9,12 292:5 293:20,23 296:15,19 297:12 337:5,21,22 339:6 340:13 360:18,21 361:3,16 362:19 363:1 <b>methods</b> 321:6,20 <b>middle</b> 258:8,10 291:7 350:15 354:10 <b>midpoint</b> 307:14 330:16 <b>Mike</b> 283:20 <b>miles</b> 254:6 341:16 <b>milk</b> 303:18 <b>milligrams</b> 268:22 277:21 278:9 329:13,21,22 <b>million</b> 268:1 312:11 313:5 313:16 319:14 321:17 322:6 329:7 333:5,7,13 356:4 <b>mind</b> 297:2 320:3 366:8 <b>mine</b> 288:9 <b>minimum</b> 330:3 <b>minus</b> 330:2 <b>minute</b> 287:1 355:7 <b>mirrors</b> 311:6 <b>misleading</b> 351:18 352:15</p>	<p>353:8 <b>misread</b> 327:21 333:9 <b>missing</b> 307:3 310:8,10,12,17 310:22,23,24 314:11 <b>misspoke</b> 327:22 <b>mistake</b> 361:13 <b>model</b> 308:21 <b>modified</b> 337:14 <b>modify</b> 337:12 <b>moment</b> 293:9 317:10 354:19 <b>morning</b> 258:2,3 286:3 <b>move</b> 322:12 341:16 <b>moved</b> 274:14,18 <b>movement</b> 364:7 <b>moving</b> 331:14 <b>multiple</b> 258:17 260:9,12 281:6 <b>multiplied</b> 306:6</p> <hr/> <p style="text-align: center;"><b>N</b></p> <hr/> <p><b>N</b> 255:1 256:1,3 <b>name</b> 283:1,3 294:18 <b>named</b> 357:23 369:9 <b>names</b> 283:8,21 <b>Nance</b> 255:3 256:5 257:8,8 258:1 275:18 286:25 288:2 289:10 292:18 295:8 317:14 317:17 331:13 333:11,17 334:5 365:18 <b>National</b> 303:7,13 308:4 321:12 <b>nationwide</b> 262:7 <b>NATURAL</b> 254:7 <b>near</b> 266:11 325:15,18 <b>necessarily</b> 335:16 <b>necessary</b> 270:10 363:20 <b>need</b> 259:8 264:6 274:17,21 276:6 277:8,16 291:15 292:8 304:20 309:3,4,6,14 309:20,25 310:1 311:7 317:13 329:5 330:1 331:6 337:18 345:23 347:7,15 356:20 <b>needed</b> 259:1 293:14 308:20 308:23 322:6 332:11 339:19</p>
---	---	---

<p>340:23 357:12  <b>needs</b> 356:2,3  <b>negative</b> 349:5,7,8 352:13,17  <b>negligent</b> 279:5,12,18,21  280:11  <b>net</b> 305:19  <b>never</b> 284:6 286:2 314:18  320:3 328:21 338:9  <b>Nevertheless</b> 337:4  <b>new</b> 288:14  <b>nine</b> 312:11  <b>nitrogen</b> 270:11,22 274:12  276:4,7,14,17,20 277:8,11  277:16  <b>nitrogen-based</b> 270:12,18  <b>non-statistician</b> 302:6  <b>normal</b> 327:10  <b>North</b> 255:15  <b>NORTHERN</b> 254:2  <b>Notary</b> 368:21  <b>notes</b> 369:12  <b>notice</b> 278:8 342:2  <b>noticed</b> 359:18  <b>number</b> 285:6 303:9 304:4  306:18,21,22 307:3 309:21  310:2,7,13,19 311:25 312:3  312:18 314:10 315:12,16,19  316:16 319:12,13 324:18  327:19,22 330:14,18,24  331:1,2 332:2 348:14 350:9  350:10 351:3,15 356:19  363:10 370:3  <b>numbered</b> 254:17 286:17  342:15 368:6  <b>numbers</b> 285:1 296:16  300:21 304:9,12,16 305:22  306:1 308:17 313:17,25  315:17,23 332:19,21,24  350:1 351:12  <b>numerical</b> 259:19  <b>numerous</b> 263:12  <b>nutrient</b> 269:3 274:9 337:7  340:17 345:9 348:3 361:5  <b>nutrients</b> 357:11</p>	<p style="text-align: center;"><b>O</b></p> <p><b>O</b> 255:18  <b>object</b> 259:2 261:3,7,14,21  262:2 263:2,8 272:14 273:3  273:21 289:11,17,19 299:19  304:23 307:10,21 311:1,9  323:6,14,19 325:16 335:5  337:13 339:16 340:5,20  344:6 345:17 346:8,17  347:12 352:14 353:7 355:9  355:21 357:16 358:18  359:11,11,17 360:20 361:22  363:7 364:22 365:4  <b>objection</b> 274:6 346:10  352:18  <b>objections</b> 359:15,20,22  <b>objective</b> 258:12  <b>objectives</b> 362:6  <b>observation</b> 277:5 350:12  354:3  <b>observations</b> 325:1 353:24  354:5,8,12  <b>obtain</b> 328:6 331:24  <b>obtained</b> 298:8 315:13,19  <b>obvious</b> 353:25  <b>occurs</b> 258:24 356:25 357:2  <b>odd</b> 312:11  <b>offer</b> 289:4,18  <b>offered</b> 272:15 273:23 291:10  357:20  <b>offering</b> 289:22 291:8  <b>Offhand</b> 314:15  <b>Oh</b> 285:23 320:22  <b>OK</b> 255:5,8,12  <b>okay</b> 258:7,20,24 259:6 260:7  260:17 261:5,16 262:15,17  263:11 264:9,15 265:7,10  266:14 267:1,3,9,17,21  269:3,14 270:2,24 272:2,10  273:5,16 274:23 275:2,4  276:3 277:18 278:2 279:24  280:3,8,11 282:1 283:13  284:8 285:20 286:9,15  289:3 290:9,17,23 291:3</p>	<p>292:4,10 293:9,22 294:5,17  294:24 295:2,3 296:1,5,9,18  296:20,25 297:17,20,23  298:3,6 299:9,12,17 300:6  300:10,25 301:14,20 302:6  303:7 304:3,13,19 305:2,6  305:12 306:19,22 307:15  308:13,16 309:7,13,18  310:3,6 311:11,19 313:3,3  313:13 314:16 315:6,12,25  316:16,20,23 318:8 319:7  319:20 320:3 321:14,25  322:3,9 323:3,11,16,25  324:18,20 325:22 326:19  327:3,15 328:18 329:17  330:20 331:5,9,12 332:15  332:22 334:6,13,15,21  336:13 339:6 342:6,12,13  342:21,24 343:3,11,17  344:3,24 345:14,19 346:5  346:13 347:4,10,17 348:6  348:22 349:11,13 350:3,11  351:19 352:8,12,16 353:1,3  353:11,16,19 354:6,15  355:12,18,24 356:14,22  357:1 358:2,13,22 360:8,9  361:1 362:5 364:4,6 366:14  367:3  <b>Oklahoma</b> 254:2,5,6,8,19,22  257:9,11 261:10,18 262:8  263:7,12 264:11,16,18  267:24 269:1,16 273:1  303:9 304:14 309:9,16  310:14 311:11,16 312:20  313:6,16 323:1 327:25  343:18,23 345:15 347:8,11  347:13 348:2 354:24 366:15  366:19 369:3,8  <b>Oklahoman</b> 268:24 277:24  <b>Olsen</b> 328:8,18  <b>Olsen's</b> 328:10,16,24  <b>omitted</b> 355:23  <b>once</b> 293:10 306:3 319:11  356:8  <b>ones</b> 287:13 293:18 350:13</p>
---	---	--

**online** 304:7  
**on-the-ground** 284:4  
**opening** 321:19  
**operation** 284:4  
**operator** 356:24  
**opine** 261:24 336:10  
**opining** 289:17 293:22  
 296:12  
**opinion** 261:9,16 272:17,19  
 273:22 275:19 285:7,18  
 289:18 305:21 363:18  
**opinions** 272:15 275:13 291:8  
**optimum** 267:16,18  
**order** 314:10  
**original** 277:20  
**originally** 341:24  
**OSU** 347:19  
**OSU's** 330:9  
**ought** 343:3  
**outcome** 259:10,18,21 318:5  
**outlined** 295:20 296:6 298:16  
 337:6 338:4 361:3  
**outline-type** 281:13  
**output** 321:5,7 323:25  
**outside** 272:15 273:4 274:7  
 291:16 358:19  
**overall** 260:18 262:14  
**overarching** 278:6  
**overseeded** 326:1  
**overwhelming** 353:5  
**owner** 356:24

---

**P**

---

**P** 255:1,1,18 256:3 258:12,16  
 258:20,24 259:3,16 264:1  
 264:23 265:21 266:1,3,4,5,8  
 266:9 268:21 274:4 278:7  
 279:4 284:19 337:7,8,8  
 338:13 347:23 348:15 351:1  
 360:10 361:5,5,6 362:11,14  
 363:23 364:2,4  
**page** 255:3 256:6 257:10,10  
 258:5,10 262:5 268:7,16  
 277:18 278:24 287:20 290:1  
 290:10 293:6 309:19 321:5

330:1 331:22 342:15,16  
 346:25 349:3 350:15 351:19  
 355:24 358:2 359:14 368:1  
 370:3  
**pages** 288:19,23,24 289:5,24  
 342:15 369:17  
**paid** 283:10  
**paper** 357:23 366:24  
**paragraph** 258:11 262:4,18  
 278:25,25 281:12,13 290:9  
 306:3 327:25 331:22 337:4  
 348:14 355:24 358:14 359:1  
 360:2,4,6  
**paragraphs** 287:20 310:4  
**parameters** 272:22 291:1  
**paraphrasing** 262:7  
**parenthesis** 297:7,9 312:8  
 325:24,24,25 326:1  
**parenthetical** 312:8 334:23  
**part** 290:17 294:25 302:22  
 304:14,17 305:12 313:4  
 314:3 338:3,10 341:22  
 342:4 358:10,25 359:12  
**participating** 284:9  
**participation** 294:9  
**particular** 258:15,21 259:17  
 260:5 262:23 291:5 296:5  
 310:10 352:9  
**particularly** 346:16  
**particulars** 296:1  
**parties** 369:20  
**parts** 267:25 329:6  
**pasture** 320:10 323:25 324:2  
 324:9 335:24 350:23 356:6  
 356:9,23  
**pastureland** 337:10 361:7  
**pasturelands** 327:17  
**pastures** 363:14  
**pathway** 325:21  
**patterns** 277:4  
**people** 282:10 291:15 294:17  
 307:25,25 308:5 344:25  
 345:4 346:14 362:6  
**percent** 270:1,4,14,25 271:15  
 271:17,20,21,24 278:12,15

278:16,22 313:5,16,22,23  
 315:1 320:10,23,23 324:12  
 324:14,16,21 325:5 327:6  
 328:2 330:3 332:6 333:25  
 334:1,9,11,18,21 351:2  
**percentage** 269:23 278:4  
 320:22  
**perform** 263:4  
**performed** 324:25 343:20  
**performing** 288:25  
**period** 314:13,14,20 315:17  
 319:10 321:16,16 322:5  
 324:1 327:17 331:25 343:20  
**periods** 327:5  
**permissible** 267:9  
**permitted** 269:20  
**person** 260:17  
**personal** 323:9  
**personally** 298:24 328:14  
**perspective** 284:13  
**pertinent** 293:18 304:22,25  
**per-acre** 324:7 333:4  
**per-bird** 318:1  
**Peterson** 255:10 257:12  
 367:14  
**phase** 270:15  
**phases** 274:23,24  
**PhD** 254:15 256:4 257:21  
 275:2 368:3,12 370:1  
**phone** 255:19 257:18 367:16  
**phosphorus** 258:14,21,25  
 259:5,6,7,8,12,18,22 260:8  
 260:19 261:11,18 262:1,6,9  
 262:12,19 263:1 264:21  
 265:3,5 266:20,20 267:4,7  
 267:10,14,19 268:20 269:8  
 269:9,21,22 271:2,5,6,9,12  
 272:2 274:12 275:7,21  
 276:11,11 277:21 278:2  
 280:6,7 285:15 296:22  
 297:6,8 298:8,9 303:1 306:5  
 306:7,11,13,16 320:5,7,9,12  
 320:17 321:1 322:4,6,14  
 324:11,12,14,17,21 325:11  
 325:14,23 327:7,8,16 328:1

<p>330:11,22 331:23 334:25  335:12 336:6,7 340:18  346:16 347:7,15 356:3  363:24 364:3,5,6,7,12,15,21  365:3,6,15  <b>phosphorus-based</b> 270:19,23  271:3  <b>physical</b> 263:19 264:3 311:7  336:20,23 339:1  <b>physically</b> 309:5  <b>PI</b> 268:9  <b>picture</b> 284:5  <b>piece</b> 346:4  <b>place</b> 263:20 308:5 369:18  <b>placed</b> 275:14  <b>plainly</b> 350:13  <b>plaintiff</b> 254:9,16 305:25  328:8  <b>PLAINTIFFS</b> 255:3  <b>plaintiff's</b> 295:20 296:6  305:16 316:8 319:12 341:21  <b>plan</b> 276:18 345:9 360:9,12  360:14 362:23  <b>planning</b> 276:21  <b>planting</b> 276:17  <b>Plaza</b> 255:18  <b>please</b> 257:6 258:5 290:4,5,21  295:14 317:20 326:15  351:20 352:22 362:17  367:20  <b>plot</b> 310:18  <b>plotted</b> 352:5  <b>point</b> 266:11 271:11 294:6  300:22 307:9 309:1 310:23  313:9 331:9 339:23 345:24  345:24 348:1 353:22 354:10  <b>pointed</b> 273:24  <b>points</b> 307:14 310:12 321:22  330:10 332:12 353:9,13,20  <b>policy</b> 265:3,12,13  <b>policymakers</b> 265:8  <b>political</b> 265:8  <b>poop</b> 355:8  <b>poor</b> 363:14  <b>poorly</b> 363:12</p>	<p><b>population</b> 314:2  <b>portion</b> 293:7 324:10  <b>position</b> 319:18 323:21 325:7  336:10  <b>possibilities</b> 350:9  <b>possibility</b> 348:25  <b>possible</b> 365:8  <b>potential</b> 365:10  <b>poultry</b> 289:16,22 296:22  297:10,24 298:22 304:24  305:3 306:3,23 309:9,15  319:21 320:8,13 321:1  325:14 328:7,22,23 329:1  333:24 334:8 337:6,9,10  340:14,17 343:12,12 355:25  361:4,6,7 363:13 364:20  365:3,7 366:1,2,6,11,15  <b>pound</b> 264:17 347:14  <b>pounds</b> 258:14 267:15,22,24  268:25 269:18 277:16,25  297:5 298:7 306:5,7,11  317:12,22,24 320:5,17,24  328:1 329:6,10,17 330:11  335:2 347:20  <b>powers</b> 333:17  <b>practice</b> 322:9,20,23 326:16  327:3 348:21 359:21 363:15  <b>practices</b> 300:6,8 323:5  335:13 336:11 358:5  <b>precipitation</b> 277:4  <b>precise</b> 309:2,6 341:3  <b>precisely</b> 326:4  <b>precision</b> 308:20 311:7  <b>Predict</b> 280:6  <b>prefacing</b> 361:14  <b>preliminary</b> 279:10 280:9  <b>premise</b> 346:18  <b>prepare</b> 280:23  <b>prepared</b> 280:17 287:23  288:13 293:2 303:25 331:9  <b>preparing</b> 288:25  <b>present</b> 275:1 330:25 366:24  <b>presentation</b> 366:23  <b>presentations</b> 366:18  <b>presented</b> 275:11 293:12</p>	<p>339:18 367:1 368:4  <b>presumably</b> 263:6 314:1  <b>presume</b> 322:22 324:7 332:9  346:11  <b>presumption</b> 299:25  <b>pretty</b> 286:1  <b>preventing</b> 279:24  <b>previous</b> 313:11  <b>prices</b> 341:14  <b>principally</b> 343:21  <b>principles</b> 262:6,8,10  <b>print</b> 310:7  <b>prior</b> 318:12 328:6 329:1  <b>probability</b> 272:9  <b>probably</b> 277:16 282:22  292:8 301:5 307:12 308:3  321:3 330:19 361:13,17  <b>problem</b> 275:25 340:1,3  351:10 363:25 364:19,20  365:2  <b>problems</b> 365:6  <b>procedure</b> 360:25  <b>procedures</b> 284:14 298:15  <b>proceed</b> 295:8 302:19 340:1  <b>proceedings</b> 292:14 331:18  365:22 368:6  <b>process</b> 285:7 301:11,12  <b>processes</b> 284:14  <b>produce</b> 277:17 322:6 331:24  <b>produced</b> 254:15 296:22  302:24 303:2,3,9,20 305:15  307:1,20,24 309:23 315:13  315:16,20 316:4,10,19  318:13 319:23 320:11,17  333:3,6,7 334:17 335:9,22  357:11  <b>producers</b> 343:12 346:1  366:11,15  <b>producing</b> 305:7  <b>product</b> 294:13  <b>production</b> 266:23 291:1  293:13 304:24 305:3 306:4  308:3 309:9,15 312:19  319:21,24 320:1 321:7,16  321:21 322:3,10 324:5</p>
--	--	---

330:21 334:25 337:18  
 338:14,14,15 356:1  
**productivity** 277:12  
**products** 303:17  
**profession** 317:25 336:5  
 344:25  
**program** 318:10,25 319:2  
**project** 276:18  
**properties** 336:21  
**property** 336:24  
**proportion** 351:8  
**proposition** 325:2  
**protection** 363:16,21  
**provide** 258:16 298:16 301:9  
**provided** 367:11  
**provides** 332:6  
**proximity** 322:11  
**public** 308:3 368:21  
**publication** 347:19 357:18  
**publicly** 343:22  
**pull** 304:7,8  
**purpose** 263:5 286:1 297:14  
 301:6 337:16,16 339:8  
 340:6,8,13 346:7,23  
**purposes** 263:15 264:20  
 308:20 321:4 330:17 335:17  
 335:19 337:20 338:1,4,5  
 340:21 345:4 361:15 362:1  
 362:16,20  
**put** 261:1 269:9 288:11,19  
 354:24 355:3  
**putting** 258:25 309:10  
**P-based** 337:10 361:8  
**p.m** 365:20,22,23,25 367:23  
 367:25

---

## Q

---

**quadruple** 266:18  
**qualified** 275:23 276:1  
**quality** 261:19,25 272:11,21  
 272:23,25 273:1,19 275:12  
 363:16,18,21,25 364:20  
 365:2,5,16  
**quantified** 355:13  
**quantifies** 363:23

**quantify** 364:2  
**quantitative** 258:13  
**question** 260:21 263:15  
 273:25 275:11,23 276:1  
 289:8,14,17,20,21 317:20  
 329:21 330:5,6 342:18  
 345:19 349:11 354:19 360:1  
 362:17  
**questions** 280:24 284:1,12,19  
 367:15,17,18  
**quick** 279:14 290:6 365:18  
**quickly** 295:8  
**quote** 322:15,16

---

## R

---

**R** 255:1 369:1  
**rainfall** 276:22,25  
**raise** 294:6 297:6 320:6  
 330:12,23 331:6 332:11  
 334:12  
**raised** 330:2  
**raising** 366:2  
**ran** 362:23  
**range** 302:12 330:16 352:11  
**rank** 354:8  
**ranking** 354:10  
**rarely** 318:1  
**rate** 270:7,10,12,13,18,19,22  
 270:23 271:1,2,3,3,6 277:11  
 298:7 314:1 333:1 355:25  
**rates** 284:20,20,21  
**ratings** 260:19  
**ratio** 310:1 315:12,19,22  
 316:25  
**Rausser** 287:24 292:20  
 294:11,15,21 295:3,23  
 297:23 300:4 304:9 305:2  
 307:15 314:17 322:24  
 339:13 342:11,24 346:25  
 351:21 352:4 355:19 358:4  
 359:2 360:6,16 361:21,25  
 362:13  
**Rausser's** 294:8,9  
**reach** 320:9 328:4 332:4  
 333:21,25 334:10

**reached** 279:1  
**reaching** 341:12  
**read** 258:18 279:14 280:3  
 285:16,17 291:18 295:13  
 301:12 326:14 338:23  
 357:17 360:14 361:1 367:19  
**reading** 278:10 288:17  
 291:23 313:19 334:7 350:3  
**readings** 353:5  
**reads** 290:25 316:25  
**ready** 357:19  
**real** 300:24,25 301:2 314:8  
 321:3 356:15,16  
**realistic** 320:18 350:6,10  
 356:14  
**realize** 319:11  
**realized** 300:24  
**really** 259:11 276:22 284:2  
 294:14 306:15 309:5,17  
 314:8 329:20 345:11 347:22  
 351:14 353:23  
**reask** 289:21  
**reason** 260:7,14 344:17  
 345:14,22,25 346:18  
**reasonable** 284:22,23 285:5  
 285:22 298:10 299:6,18,20  
 306:10,21 317:25 318:5  
 320:20,25 322:5 324:18,19  
 328:6 329:3,18,23 330:13  
 330:17 341:16  
**recall** 264:11,14 276:5 283:7  
 283:10,11 298:5 301:11  
 342:22 349:25 357:22 358:1  
**receive** 269:24  
**received** 328:19,21,23  
**receives** 276:23  
**recess** 292:13 331:17 365:21  
**recessed** 367:24  
**recognize** 283:1,3,8 286:6,18  
 331:2  
**recognized** 264:10 283:12  
**recollection** 283:25 290:20  
**recommendations** 346:3  
**record** 257:3,7 266:16 280:3  
 292:11,14,16,19 294:12



<p>327:20 331:15,18,20 343:19 359:25 365:19,22,24 367:23</p> <p><b>records</b> 308:3</p> <p><b>reduce</b> 274:1</p> <p><b>reduced</b> 261:12 369:13</p> <p><b>reducing</b> 315:1</p> <p><b>reductions</b> 261:24</p> <p><b>refer</b> 287:19</p> <p><b>reference</b> 270:17 281:14 290:8 347:18</p> <p><b>referenced</b> 328:25 349:7</p> <p><b>referred</b> 288:18 310:16</p> <p><b>referring</b> 348:20 360:23 361:18</p> <p><b>refers</b> 317:7 326:6</p> <p><b>reflective</b> 297:9 335:13</p> <p><b>reframe</b> 273:25</p> <p><b>regard</b> 284:11 292:25</p> <p><b>regarding</b> 351:12</p> <p><b>regardless</b> 259:3</p> <p><b>region</b> 276:25</p> <p><b>regs</b> 265:14</p> <p><b>regulators</b> 357:8</p> <p><b>regulatory</b> 264:15 358:3,9,11 358:15,21 359:8</p> <p><b>related</b> 355:11</p> <p><b>relationship</b> 309:8,15,21 310:20,22 312:19 314:12 316:10</p> <p><b>relative</b> 258:16 259:15,16 260:15 364:7 369:20</p> <p><b>relevant</b> 260:1</p> <p><b>reliability</b> 328:15</p> <p><b>reliable</b> 276:4 308:17 328:11 344:18</p> <p><b>relied</b> 328:7</p> <p><b>relies</b> 343:6</p> <p><b>remained</b> 319:22</p> <p><b>remember</b> 280:8 282:19 283:22 286:13 355:18 367:1</p> <p><b>remembering</b> 283:17</p> <p><b>removal</b> 271:3,5 284:21</p> <p><b>removals</b> 272:5</p> <p><b>remove</b> 297:8 322:10</p> <p><b>removed</b> 271:7,8 320:17</p>	<p>322:14 324:9,11,12 327:16</p> <p><b>renders</b> 358:17</p> <p><b>repeat</b> 318:22</p> <p><b>report</b> 258:4 267:20 268:8 272:16 273:4 274:7 275:15 276:4 277:19 280:23 283:5 285:11,12 286:8,21 287:9 287:17,20,24 288:17,25 290:8,9,14 292:21 293:2 294:8,25 296:3 302:23 323:22 328:14 330:15 337:4 340:12,19 342:12,14 348:6 349:15,19 358:8,10,19 359:1,3,12 360:2,6 361:19 363:6</p> <p><b>reported</b> 369:11</p> <p><b>Reporter</b> 254:20 369:7</p> <p><b>Reporter's</b> 256:7</p> <p><b>reports</b> 280:17 287:25 305:24 343:11</p> <p><b>represent</b> 290:13 342:10 344:19 346:14</p> <p><b>representative</b> 309:6 336:20 336:23 342:19,25 345:20 346:6 351:7</p> <p><b>represented</b> 309:11 351:4 353:10,13,21 357:14</p> <p><b>representing</b> 282:21,23</p> <p><b>represents</b> 270:4 316:17 334:11 347:6 351:6 354:5</p> <p><b>require</b> 332:16 337:2</p> <p><b>required</b> 297:6 298:9 307:1 320:5 322:4 328:2,11 330:12,22 331:23 332:5 333:4,21,25 334:9,12 356:5</p> <p><b>requirement</b> 330:3</p> <p><b>requires</b> 303:2</p> <p><b>research</b> 277:14</p> <p><b>RESOURCES</b> 254:7</p> <p><b>respectively</b> 332:23</p> <p><b>response</b> 266:19,21 337:9 348:17 361:6</p> <p><b>restricted</b> 262:23</p> <p><b>result</b> 267:22 268:8 275:20 291:23 296:9</p>	<p><b>results</b> 262:19 344:21</p> <p><b>retained</b> 307:15</p> <p><b>return</b> 327:5</p> <p><b>review</b> 286:21 290:21</p> <p><b>reviewed</b> 286:8 290:10 293:1 359:2</p> <p><b>revised</b> 305:17</p> <p><b>ridiculous</b> 339:2</p> <p><b>right</b> 259:14 260:6,24 265:24 266:24 268:4,25 270:17 271:24 278:20,23 286:12 287:15 289:7 290:11 291:23 294:14 295:5,5,12 297:21 302:22,24 305:14 307:5 310:3 311:24 313:8 314:20 314:25 316:3 317:10 319:17 320:14 326:10,23 330:8 335:16 338:3,24 342:10 343:5 344:11 348:4,24 349:18 351:8,22,24 353:2 354:1,11 359:5,10 362:22 363:22,25 366:8,10</p> <p><b>rigor</b> 341:4</p> <p><b>rigorous</b> 335:7 337:1,23 339:23 360:24 361:25 363:9</p> <p><b>riparian</b> 324:23 327:9</p> <p><b>risk</b> 258:16,24 259:3,15,16,22 260:1,3,15 262:14 278:15 280:7 363:23,24 364:2,3,4,7 364:14</p> <p><b>River</b> 261:6,13,20 263:16 269:4,15 272:12 273:18 274:4 275:6,8,14 277:2 298:23 299:6 301:3 319:1,5 321:2 322:20 323:13 329:4 335:23 341:18 365:9</p> <p><b>Robert</b> 255:3,17 282:17</p> <p><b>role</b> 291:18,22</p> <p><b>room</b> 295:5,7 309:18 367:16</p> <p><b>rough</b> 265:20</p> <p><b>roughly</b> 259:20 265:19,20,23 321:16 324:12</p> <p><b>routinely</b> 345:1</p> <p><b>rubber</b> 317:18</p> <p><b>run</b> 263:22 300:13</p>
---	--	---



<b>runoff</b> 266:1,2,3,5,8,10	303:24,25 335:4,6 357:23	<b>seriously</b> 317:15
<b>S</b>	<b>scientists</b> 339:1	<b>Service</b> 303:8,14 308:4
<b>S</b> 255:1 256:3,3	<b>scope</b> 272:15 273:4 274:7	321:13
<b>safe</b> 289:3	295:4 358:19	<b>set</b> 262:5 265:18 287:3 347:9
<b>sale</b> 327:8	<b>Scott</b> 255:10 257:12 286:25	<b>sets</b> 288:10 343:17
<b>sample</b> 276:17,19 328:25	288:2 292:18 359:15	<b>seven</b> 328:21 341:16 366:21
346:19 347:5 350:7,17,22	<b>SEAL</b> 369:22	<b>seven-year</b> 343:20
351:5,16,17	<b>second</b> 275:9 286:20 289:8	<b>Shaking</b> 367:15
<b>sampled</b> 328:22	297:12 299:4 317:3 320:19	<b>share</b> 313:20
<b>samples</b> 270:5,8,25 271:17	342:19 347:4	<b>shared</b> 283:15
328:8,13,18 346:1 347:11	<b>SECRETARY</b> 254:6	<b>shocking</b> 336:2
351:3	<b>section</b> 281:14,14 288:18,20	<b>short</b> 292:13 296:13 327:4
<b>sampling</b> 350:4 360:9,12	289:19 290:10 358:7 359:2	331:17 365:21
<b>Sanders</b> 255:17 257:19,19	359:12 360:5	<b>Shorthand</b> 254:20 369:7
367:18	<b>sections</b> 285:12,17 286:20	<b>show</b> 279:8 286:15 310:4
<b>satisfied</b> 308:5	<b>see</b> 265:21 276:10,11 279:14	341:20
<b>saved</b> 325:25	279:16 282:7 286:6,9,18,22	<b>showing</b> 265:19 352:9
<b>saw</b> 285:12 286:2,11 287:13	288:24 290:19 304:15,18	<b>shown</b> 352:16 354:20
338:9 344:2 349:16	341:23 347:2 349:6 352:8	<b>sic</b> 317:7 322:15 357:24
<b>saying</b> 261:1 275:23 307:6	352:12,16,23 353:11 354:25	<b>side</b> 261:11,12 295:7
311:16 321:19 336:18	355:2 361:9,10 362:2,24	<b>Sidley</b> 282:12
337:25 340:6 349:25 350:14	<b>seen</b> 300:23 311:19,23 331:1	<b>sign</b> 367:20 368:7
361:14 363:19	337:21 338:22 341:9,17	<b>Signature</b> 256:6 368:1
<b>says</b> 258:11 265:16 269:12	343:10,16 357:13,23 364:23	<b>similar</b> 263:10 288:10 321:6
277:23 279:7,12,18 295:18	<b>segments</b> 286:7	321:20 341:17
296:9 298:15 299:12 309:7	<b>semicolon</b> 319:24	<b>simple</b> 336:15 348:22
310:7 312:9,14 319:20	<b>send</b> 346:2,19 367:20	<b>simply</b> 271:4 289:12 306:5
324:5 330:11 331:23 334:7	<b>sending</b> 344:14 346:23 350:7	347:7
340:12 343:6 347:1,13	<b>sense</b> 281:21 284:15 285:25	<b>single</b> 260:10 350:22 351:1,5
355:25 359:12	297:4 303:6 326:3,5 355:15	<b>sir</b> 263:14 267:8 269:2,13
<b>scale</b> 259:19,20 352:11,19	<b>sentence</b> 258:11 259:15	271:13 277:19 278:11
<b>scenario</b> 293:15	278:25 295:18 298:15 303:5	280:14,16,22 281:17 285:3
<b>science</b> 273:9,15 293:19	304:3 305:22 309:17,23	286:24 287:18,22 291:6
297:19 299:21 338:3 340:4	313:11,13,20 315:18 316:18	296:13 298:21 304:11
340:16	316:22 317:4 318:8 319:7	305:23 311:24 312:13 313:7
<b>scientific</b> 265:15 279:1	321:19 324:5 325:22 327:3	314:18 323:24 325:9 326:24
336:25 337:23 338:2 339:23	327:6 329:12 332:4 334:3,7	334:3 341:3 352:11 355:14
340:7 341:2 345:6 362:3,21	336:17 347:4 348:13 355:25	360:17 366:10,13,17
363:5,8,9	358:14 362:9	<b>sit</b> 288:7
<b>scientifically</b> 302:18 307:8	<b>sentences</b> 360:4	<b>site</b> 259:17,22 264:20 265:5,6
310:24 323:12 325:8 335:2	<b>separate</b> 279:13 285:17	266:9 267:10,19 270:8
340:25 360:24	294:14 354:3	276:22 364:6,8
<b>scientist</b> 280:12 284:13,15,18	<b>Sequoyah</b> 304:15,17,21,25	<b>sites</b> 259:10,11 262:19 268:13
298:11 299:5 300:25 302:18	309:11 354:24 355:1,3	269:19,20,21,23,24 270:14
	<b>SERA-17</b> 279:6	271:25 277:20 278:3

**situation** 288:14  
**situations** 277:10 284:5  
**six** 275:10 333:17  
**size** 355:11  
**Slanton** 357:24  
**slope** 299:23 300:3 310:20  
**sloped** 299:24  
**small** 350:21  
**snail** 294:21  
**soil** 263:21,22,23 265:3 266:2  
 266:3,8 267:20,21 268:21  
 275:20 276:7,8,9,11,12,15  
 276:17,20 277:21 278:7  
 280:12 284:13,15,17,19  
 285:15 287:12 291:2 293:19  
 297:18 298:11 299:5,21  
 300:25 302:18 303:24 320:9  
 326:20 328:7,25 335:3,6  
 336:20,23 337:8,8 338:3,13  
 340:14 343:8,11 344:3,5,19  
 344:21,22,24 345:3 346:1  
 346:19 347:22 348:15  
 350:22,25 351:5,12 360:10  
 360:12 361:5,6 362:11,14  
 362:21  
**soils** 263:21 265:21 278:15  
 299:4,10  
**soluble** 265:21 266:1,2,3,4,5  
 266:8,9  
**sorry** 298:14 327:22  
**sort** 265:7 346:5  
**sound** 284:22,23 285:9,16,19  
 291:22 292:3,5 293:23  
 317:24  
**sounded** 285:5  
**Sounds** 268:2  
**source** 262:12 274:22 279:2,4  
 279:19 315:20,21 320:7,12  
 321:1 322:18 325:22 335:12  
 336:7 365:11  
**sources** 365:8  
**South** 255:11  
**speak** 268:24 290:2 298:14  
**speaking** 272:10 277:24  
 289:15 303:21 359:15,22

**speaks** 359:13  
**specific** 258:13 273:12  
 360:13,13 361:17  
**specifically** 282:19 295:25  
 306:14 349:25 365:17  
**Specified** 291:2  
**speculate** 329:20  
**spoke** 284:10  
**spot** 283:16  
**spreadsheets** 349:6  
**square** 347:21  
**ss** 369:3  
**stand** 340:16,24  
**standard** 269:16  
**standards** 272:24 273:1  
**start** 291:3 295:16 308:5  
**started** 300:23  
**starting** 300:22 333:12  
**state** 254:5,8,19,22 257:8,10  
 262:20 263:17 265:2,12,13  
 265:14 267:3 268:11 320:14  
 327:25 343:18 345:15,16  
 348:1 349:22 357:9 367:4  
 369:3,8  
**statement** 327:12  
**States** 254:1 365:1,14  
**statistic** 302:8  
**statistical** 347:1  
**statistically** 360:11 361:11  
 362:10,13  
**Statistics** 303:8,13 304:8  
 308:4 321:13  
**status** 360:11 362:11,15  
**stays** 324:17  
**steady** 271:13  
**steep** 299:24  
**steeper** 266:12  
**Steinmeyer** 254:20 368:5  
 369:6,24  
**stenograph** 369:12,12  
**step** 296:21 297:2,5,12 298:6  
 298:8,10 302:23 320:4,4  
 333:1,20  
**steps** 296:18 302:16 333:1  
**Stevenson** 359:16

**stockpiled** 325:25 326:6,22  
**stop** 275:16 317:10  
**storage** 322:11 326:19,22  
**story** 295:9  
**STP** 261:13,24 271:19,25  
 274:1 278:14,19 290:25  
 295:21 296:10,11 297:6,9  
 298:7,9,16 301:8,10,18  
 302:3,7 309:2,5 311:6 320:6  
 320:9 326:20 327:1 328:1,3  
 328:4,12,16 329:1,2,23  
 330:1,9,10,12,23 331:24  
 332:4,5,9,15 333:1,4,21,22  
 334:1,2,10,12 335:1 336:16  
 339:12 347:6,21 348:3  
 349:5 350:24 351:6 352:17  
**STPs** 272:12 273:17 275:5,20  
 328:6 339:15 355:5  
**stream** 325:10,15,17,18,20,20  
**streams** 324:23  
**Street** 255:4,7  
**strike** 299:5 329:3  
**strikes** 280:11  
**strokes** 272:10  
**students** 273:8,15 274:2,8,17  
 315:9  
**studied** 267:8 355:12  
**studies** 277:14  
**study** 262:17 318:18 323:12  
 341:9,10,17 345:6 364:17  
**studying** 364:25  
**stuff** 344:10  
**styled** 254:17 368:6  
**subfield** 260:11  
**subfields** 260:5  
**Subheading** 313:9 316:3  
**subject** 262:18 289:5  
**submitted** 343:12 361:20  
**Subparagraph** 258:9 318:9  
**Subpart** 342:4  
**subparts** 262:18  
**SUBSCRIBED** 368:17  
**subset** 268:18,18,20 277:19  
**substance** 274:10,11 281:15  
**substantive** 288:6 358:10

**subwatersheds** 263:13  
**sufficiency** 328:3  
**sufficiently** 328:11  
**suggest** 294:13 336:6  
**suggested** 280:13  
**suggestion** 305:6 336:2  
**suggestions** 281:23  
**Suite** 255:8,12  
**supervision** 369:14  
**supply** 270:11 335:1  
**supplying** 320:7  
**support** 325:1 348:7  
**supposed** 258:20  
**sure** 260:21 264:25 269:17  
     281:7 293:6 316:21 348:2  
     350:12  
**surface** 273:6  
**surplus** 357:10  
**surprise** 336:4,5,8 357:14  
**surprised** 300:22  
**survey** 324:25  
**surveys** 303:19,22,23 304:1  
**suspect** 344:21 356:25  
**swear** 295:9  
**sworn** 257:22 368:17 369:9  
**system** 274:23  
**systems** 293:14 337:18

---

**T**

---

**T** 256:3 369:1,1  
**take** 258:4 259:17 276:17  
     288:12 316:23 338:1,7  
     346:1,19 362:4 365:18  
**taken** 254:17 306:1 328:8,18  
     369:18  
**takes** 358:4  
**talk** 280:10 294:15 298:19  
     348:22 354:23  
**talked** 264:9,11 267:18 279:9  
     294:25 348:4 355:4 356:18  
     360:21,21 367:9  
**talking** 279:11 280:4,20  
     285:10 313:10 329:6,10  
     342:20 356:3 359:3 360:5  
**talks** 343:4

**tapes** 292:8 331:13  
**target** 277:8  
**teach** 273:8,11,14 274:2  
     315:9,11  
**teaching** 364:24  
**team** 294:11  
**technical** 291:20  
**techniques** 347:1  
**tell** 258:20 279:16 282:1  
     288:7 290:23 292:4 293:10  
     295:12 300:7 303:12 310:14  
     316:20,21 339:7  
**telling** 272:18  
**ten** 333:17  
**tend** 265:21  
**tendency** 301:18 302:3,7  
     336:16  
**terms** 271:14 278:4 289:15  
     338:13 339:15 344:13  
**test** 265:3 267:20,22 268:21  
     276:9,11 277:21 278:7  
     284:19 337:8,8 338:13  
     343:11 344:3,5,22,24 347:5  
     347:23 348:15 350:25  
     351:12 361:5,6 362:11,14  
     362:22  
**tested** 344:20,22 346:7 350:8  
**testified** 257:23  
**testify** 257:22 293:2 369:9  
**testimony** 289:4,22  
**testing** 276:7,8  
**tests** 276:4,20 343:8,19 345:3  
     349:21 361:12  
**text** 313:4 318:8 354:23  
**Theresa** 255:6 257:16  
**thing** 274:17 279:13 309:7  
     329:8  
**things** 262:15 265:16 284:22  
     295:14 296:19 298:17  
     315:10 338:18 339:21  
     340:15,18,25 345:8  
**think** 264:9 271:20 276:3  
     287:25 288:19 291:24 306:8  
     307:19 309:3,4,6 317:7,15  
     323:1 328:5 329:20 330:14

    331:1,2 333:9,12 335:17  
     336:18 337:23 339:10,20  
     341:1 342:4 347:23,25  
     348:9,20 356:18 362:6  
     363:1,4 367:12  
**thinking** 275:2 288:12 323:3  
**third** 290:1  
**thought** 285:19 287:12 318:5  
     339:6 359:14 361:16  
**three** 264:17,23 265:1,11,16  
     274:22,24 298:6,11 309:9  
     310:4,5,14 328:19 333:1  
     343:17 359:18  
**three-year** 270:20,23  
**threshold** 264:16 265:2,3,4  
     265:10 267:4,11 268:14  
**time** 257:5 275:15 276:17  
     282:11 286:11,16 292:12,17  
     314:13,14,20 315:17 319:10  
     321:16 322:13 326:9 328:13  
     331:16,21 341:15 365:20,25  
     366:20 367:23 369:18  
**times** 264:17,23 265:1,11,16  
     275:10 291:15 295:13  
     338:25 351:10  
**title** 280:4,6 290:24 295:17  
**today** 257:5 280:21 292:23  
     359:19  
**TOLBERT** 254:6  
**told** 275:11 281:8 339:10  
     340:2,3,8  
**ton** 306:7,11,13 320:16,23,23  
**tonnage** 317:5 327:21  
**tons** 277:15 303:3 305:19  
     306:5 310:2 316:7,8,13,22  
     317:1,8,9,11,21 318:4,9,12  
     318:14 319:8,9,14,21,23,25  
     321:17 322:4,6 327:18,23  
     330:22 331:6,25 332:7,7,16  
     332:17,17,22,22 333:2,3,5,7  
     333:14,20,22,24 334:8  
     356:4,10  
**top** 309:19 321:5 330:1  
**topics** 290:2  
**topography** 263:19

**total** 296:21 297:5 302:23  
 306:25 311:25 312:1 313:21  
 314:10 316:3 318:12 319:9  
 319:22,25 320:5 321:15  
 324:2,4,5,7 327:16 331:23  
 332:7 333:2,3  
**touched** 289:14  
**track** 303:16  
**transcribed** 369:13  
**transcript** 368:5 369:17  
**transient** 276:16  
**transitional** 270:15  
**transport** 262:12 274:22  
 279:3,19 325:11,13,21  
**transported** 258:15 274:10  
 274:19 322:15 324:22  
 325:19 327:8 341:7  
**transporting** 341:11  
**trial** 289:4  
**tried** 303:19  
**tries** 363:24  
**triple** 266:18  
**true** 276:2 298:25 299:1  
 301:17 302:2,13,19 335:15  
 335:16,20,21,22 336:1  
 346:22 368:5,7 369:17  
**truly** 309:5  
**trust** 352:4  
**TRUSTEE** 254:7  
**truth** 257:22,23,23 369:10,10  
 369:10  
**try** 275:13 298:14 303:16  
 308:7,10 314:24 317:11  
 331:13 351:13 363:9 364:2  
**trying** 273:22 275:16 293:13  
 296:14 309:2 314:6 335:18  
 339:8 345:2,6 364:14  
**Tucker** 255:14 257:14,14  
 282:25  
**Tulsa** 254:18,19 255:5,8,12  
 369:4,7  
**turkey** 306:23 355:16  
**turkeys** 303:21 312:9,12,15  
 312:16,21,24,25 355:5,7,8  
 355:19,23

**turn** 258:5 268:16  
**Turning** 349:3  
**twice** 273:24 284:11  
**two** 259:24 260:3,15 262:1,13  
 270:18,19,21 276:13 282:9  
 283:21 285:17 286:20  
 288:10,19,23 289:5,24  
 295:11 297:5 307:14 309:10  
 309:18 317:4 320:4,8 323:4  
 333:2,20 343:7,11,13  
 348:14 352:20 356:9 359:19  
 360:4 362:6  
**type** 263:21,23 299:15,23  
 300:1 360:13  
**types** 263:21 299:13,14,18  
**typewritten** 369:14  
**typical** 284:3  
**typically** 306:17  
**Tyson** 254:11 343:14

---

### U

---

**uh-huh** 269:5 287:2 298:12  
 298:13 302:17 314:23  
**uncharacteristic** 300:11  
 301:2  
**underlying** 340:4  
**underpin** 262:6  
**understand** 260:21 264:24  
 266:17 268:8 270:3 272:21  
 274:21 284:2 288:13 295:14  
 306:15 307:18 318:17 328:5  
 334:24 337:15 338:5 339:10  
 340:10 351:23,24 352:2  
 354:2  
**understanding** 264:25  
 269:11,13,17 291:11 300:13  
 305:13 335:25 341:5 345:22  
 356:13  
**understood** 339:5  
**uniform** 298:19 299:10,14  
 300:16  
**uniformity** 299:4  
**uniformly** 298:22 333:23  
 334:2 335:10,23 356:17  
**unit** 330:12

**United** 254:1 365:1,14  
**units** 316:20,21 329:5 330:2  
**university** 273:15 274:3  
 315:10 327:25 343:18,19  
 346:23  
**unmet** 356:20  
**upfront** 338:25  
**usability** 277:6  
**USDA** 303:13,15 304:1  
 311:13  
**USDA's** 303:7  
**use** 260:8 261:10 262:25  
 264:2 265:11 267:9 276:12  
 281:9 285:21 310:17 315:22  
 323:12 325:25 337:22 345:5  
 348:10 351:11 362:13  
 363:10  
**useful** 276:20,23,24 363:15  
**useless** 277:1  
**uses** 327:25 362:7  
**usually** 277:10 338:23  
**utilization** 326:9 337:7  
 340:18 361:5  
**utilize** 362:10  
**utilized** 299:2  
**utilizing** 264:2

---

### V

---

**valid** 260:16 262:25 297:2,11  
 302:18 307:8 310:24 312:6  
 315:6 323:12,17 335:3  
 338:21 341:2 360:12 361:11  
 362:10,14 363:2  
**validate** 325:7  
**validated** 363:5  
**validity** 339:14  
**value** 259:21 301:18 302:3,9  
 302:14,19 307:12 309:5  
 310:21 338:11 349:5,15  
 350:18 351:6 352:9,12,16  
 353:19 354:5,9  
**values** 337:8 349:7,8,11,16  
 354:20 361:6  
**variability** 306:13  
**variable** 276:16 300:2

**variably** 299:3  
**varying** 345:4  
**verify** 304:9,11 352:7  
**version** 286:9,22 290:14  
**versus** 278:16,22 299:24,24  
 309:16 310:18 315:20  
 345:12  
**VIDEOGRAPHER** 257:3,18  
 292:11,16 331:15,20 365:19  
 365:24 367:21  
**VIDEOTAPED** 254:14  
**view** 276:7 307:9 339:23  
 350:16  
**virtue** 254:21  
**Volume** 254:14 257:4 370:2  
**vouch** 297:17,18 303:25  
 319:18 331:10 333:18  
 358:22  
**vs** 254:10

---

### W

---

**W** 254:4 256:3  
**walk** 290:17 295:15  
**want** 260:11 273:6 276:6,13  
 280:5 287:4 294:8,10,11  
 297:3 299:19 302:11 335:6  
 356:24 359:25 363:4  
**wanted** 338:7 339:4 340:22  
**wanting** 260:18,22 307:23  
**wants** 367:19  
**wash** 258:21  
**Washington** 304:5 321:10  
 351:25 357:10  
**wasn't** 300:22 308:5 342:1  
 366:22,23  
**water** 261:19,25 272:11,21  
 272:23,25 273:1,6,19 274:4  
 274:15,17,19 275:7,12,21  
 363:16,18,21,25 364:3,9,11  
 364:15,20 365:2,5,6,15  
**waters** 273:19  
**watershed** 258:18 260:13,20  
 261:1,6,13,20,25 262:23  
 263:17 269:3,15 272:5,12  
 272:13,22 273:18,20 274:1

274:5,11 275:6,8,14 277:2  
 297:25 298:17,23 299:3,7  
 299:11,14 300:2,12 301:3,5  
 301:9,19 302:4 304:14  
 305:9,12 307:24 317:6  
 319:1,5 320:12 321:2  
 322:21,22 323:5,10,13  
 326:12 327:7 329:4,19,24  
 334:17 335:12,23,24 336:7  
 336:16 338:12 339:15  
 341:18 343:1,9 348:3 356:9  
 356:20,23 364:18,25 365:9  
 365:13  
**watersheds** 260:9 262:20  
 263:12,13,16,17 365:10  
**water-holding** 324:24  
**way** 288:1 293:12 295:16  
 302:19 307:8 310:25 315:3  
 315:6,9,11 325:8 328:15  
 329:25 334:22 337:25  
 339:19,21,22 354:1 366:7,8  
**web** 281:19 282:2,6  
**WebEx** 282:4 283:5,14  
 294:18 357:20  
**website** 279:6,7 282:4  
**weigh** 339:3  
**weight** 350:12  
**weighted** 301:7,10 302:10,10  
 302:11 336:14 350:14,16  
 351:17  
**went** 281:16 301:11,12  
 308:14 341:15,22  
**weren't** 359:14  
**west** 255:4,7 263:23  
**we'll** 297:1 301:14,24,25  
**we're** 264:25 280:20 285:24  
 292:22 293:6 296:14 306:8  
 310:3 313:10 328:9 331:15  
 337:17 342:20 356:7  
**we've** 280:4 331:1 338:18  
 348:4 359:3  
**wide** 263:4,6,9  
**willing** 335:3 340:16,24 352:4  
**winter** 322:11 327:5,10  
**witness** 254:16 275:17 368:8

369:9,22  
**witnesses** 367:17  
**wondering** 267:21  
**wooded** 324:23 327:9  
**word** 279:21,21,22,23,25  
 280:12,12,13 288:8 299:15  
 333:13 334:4 335:17 342:16  
**words** 292:6  
**word-by-word** 342:1  
**work** 263:23 291:25 294:3,13  
 295:16 311:19 317:21  
 344:25 353:25 355:13  
 358:23 359:7 367:7  
**worked** 291:13 350:19  
 355:13  
**working** 281:1 300:14  
**works** 267:6  
**world** 291:16 300:20,24,25  
 301:2 311:7 321:3 356:15  
 356:16  
**worry** 308:22  
**worse** 337:21  
**worthless** 358:17,23 359:7  
**wouldn't** 260:11 264:2 272:8  
 299:10 326:24 327:2 335:25  
 337:22 356:16 361:23  
**writing** 280:2 281:21  
**written** 312:25  
**wrong** 311:12 347:7  
**wrote** 281:15 361:14,19  
 363:6

---

### X

---

**X** 256:1 277:15 352:19,23  
 353:16 354:1

---

### Y

---

**yeah** 287:13 288:23 297:17  
 306:9 318:6,7 320:20 329:9  
 330:19 355:2  
**year** 270:18,21 276:13,21  
 296:23 305:16 307:12,13,13  
 310:10,17,18,22 315:2  
 318:12 356:7  
**years** 270:18,19,21,21,22



276:14 291:14 295:11	273:20,25	10:00 292:12,13
300:14 307:3,4 310:8	09:26AM 274:5,10,15	10:11AM 292:15
312:17 314:11 316:6 328:21	09:27AM 274:20,25 275:5,10	10:12AM 292:20,25 293:5
328:24 343:7,22 351:10	275:15	10:13 292:14,17
358:7 366:22	09:28AM 275:20,25 276:5	10:13AM 293:10,15,20
yesterday 264:9 267:13,18	09:29AM 276:10,15,20,25	10:14AM 293:25 294:5,10,15
286:3,16 356:18	09:30AM 277:5,10,15	10:15AM 294:20,25 295:5,10
yield 277:12 320:10 324:8	09:31AM 277:20,25 278:5	295:15
328:2 332:6	09:32AM 278:10,15,20,25	10:16AM 295:20,25 296:5,10
yields 297:7 324:1,6	09:33AM 279:5,10	10:17AM 296:15,20,25 297:5
	09:37AM 279:15,20,25 280:5	10:18AM 297:10,15
<b>Z</b>	09:38AM 280:10,15,20,25	10:19AM 297:25 298:5,10,15
zero 352:20	281:5	10:20AM 298:20,25 299:5
	09:39AM 281:10,15,20,25	10:21AM 299:10,15,20
<b>0</b>	09:40AM 282:5,10,15,20	10:22AM 299:25 300:5,10
0.0058 316:11,16 317:21	09:41AM 282:25	10:23AM 300:15,20,25 301:5
0.0069 316:25 318:4	09:42AM 283:5,10,15	10:24AM 301:10,15,20,25
000281 286:5	09:43AM 283:20,25 284:5	10:25AM 302:5,10,15
000285 286:17	09:44AM 284:10,15,20,25	10:26AM 302:20,25 303:5,10
0058 317:11	09:45AM 285:5,10,15	10:27AM 303:15,20,25
09:03AM 257:5,10	09:46AM 285:20,25 286:5	10:28AM 304:5,10,15
09:04AM 257:15,20 258:5,10	09:47AM 286:10,15,20,25	10:29AM 304:20,25 305:5
09:05AM 258:15,20,25 259:5	09:48AM 287:5	10:30AM 305:10,15,20,25
09:06AM 259:10,15,20,25	09:49AM 287:10,15,20	10:31AM 306:5,10,15,20
260:5	09:50AM 287:25	10:32AM 306:25 307:5,10
09:07AM 260:10,15,20	09:51AM 288:5,10,15	10:33AM 307:15,20,25 308:5
09:08AM 260:25 261:5,10,15	09:52AM 288:20,25	10:34AM 308:10,15,20,25
09:09AM 261:20,25 262:5	09:53AM 289:5,10	10:35AM 309:5,10,15,20
09:10AM 262:10,15,20,25	09:54AM 289:15,20,25	10:36AM 309:25 310:5,10
09:11AM 263:5,10,15,20	09:55AM 290:5	10:37AM 310:15,20,25
09:12AM 263:25 264:5,10,15	09:56AM 290:10,15,20	10:38AM 311:5,10,15
09:13AM 264:20,25 265:5	09:57AM 290:25 291:5,10	10:39AM 311:20,25 312:5,10
09:14AM 265:10,15,20,25	09:58AM 291:15,20,25 292:5	10:40AM 312:15,20,25
09:15AM 266:5,10,20	09:59AM 292:10	10:41AM 313:5,10,15
09:16AM 266:25 267:5,10,15		10:42AM 313:20,25 314:5
09:17AM 267:20,25 268:5	<b>1</b>	10:43AM 314:10,15,20
09:18AM 268:10,15	1 258:5 320:23	10:44AM 314:25 315:5,10
09:19AM 268:20,25 269:5,10	10 287:6 290:15 291:24 293:3	10:45AM 315:15,20,25
269:15	324:12,13,16 327:6 328:23	10:46AM 316:5,10,15
09:20AM 269:20,25 270:5,10	330:15	10:47AM 316:20,25
09:21AM 270:15,20,25 271:5	10C 287:20 290:9 337:4	10:48AM 317:5,10,15
09:22AM 271:10,15	340:18 359:1 361:2	10:49AM 317:20,25
09:23AM 271:20,25 272:5	10D 360:2 362:9	10:50AM 318:5,10
09:24AM 272:10,15,20	10E 363:12	10:51AM 318:15,20,25
09:25AM 272:25 273:5,10,15	10,139,750 319:23	10:52AM 319:5,10,15,20



<b>10:53AM</b> 319:25	<b>11:34AM</b> 341:25 342:5	<b>12:17</b> 365:22,25
<b>10:54AM</b> 320:5,10	<b>11:35AM</b> 342:10,15	<b>12:17PM</b> 366:15,20,25 367:5
<b>10:55AM</b> 320:15	<b>11:36AM</b> 342:20,25 343:5,10	<b>12:18PM</b> 367:10,15
<b>10:56AM</b> 320:20,25 321:5	<b>11:37AM</b> 343:15,20,25 344:5	<b>12:19PM</b> 367:20,25
<b>10:57AM</b> 321:10,15,20	<b>11:38AM</b> 344:10,15,20,25	<b>12:20</b> 367:23,25
<b>10:58AM</b> 321:25 322:5,10,15	345:5	<b>120</b> 328:3 330:9 332:10,11,15
<b>10:59AM</b> 322:20,25 323:5,10	<b>11:39AM</b> 345:10,15,20,25	334:22 347:23 353:17,19,21
<b>100</b> 255:7 320:10 328:2 330:3	<b>11:40AM</b> 346:5,10,15,20	354:15,17,21
332:6,12 351:6 353:12,14	<b>11:41AM</b> 346:25 347:5	<b>129,633</b> 327:18
<b>101</b> 353:11	<b>11:42AM</b> 347:10,15,20,25	<b>129,663</b> 327:23
<b>11</b> 287:15 293:3	<b>11:43AM</b> 348:5,10,15,20	<b>13</b> 268:7 278:12,14 341:21
<b>11,446,443</b> 332:16,17	<b>11:44AM</b> 348:25 349:5,10,15	342:8 359:4
<b>11.6</b> 317:23,24	<b>11:45AM</b> 349:20,25 350:5,10	<b>13.7</b> 320:17,24
<b>11.8</b> 321:17 322:6	<b>11:46AM</b> 350:15,20,25	<b>132,645</b> 330:22 331:6
<b>11:00AM</b> 323:15,20,25 324:5	<b>11:47AM</b> 351:5,10,15,20	<b>15</b> 268:16 270:25 278:16
<b>11:01AM</b> 324:10,15,20	<b>11:48AM</b> 351:25 352:5,10	328:23 330:15
<b>11:02AM</b> 324:25 325:5,10,15	<b>11:49AM</b> 352:15,20,25 353:5	<b>15,000</b> 349:12,15 350:3 352:9
<b>11:03AM</b> 325:20,25 326:5,10	<b>11:50AM</b> 353:10,15,20	<b>15.57</b> 313:16
<b>11:04AM</b> 326:15,20,25	<b>11:51AM</b> 353:25 354:5,10	<b>150</b> 268:21 277:21 278:9,15
<b>11:05AM</b> 327:5,10,15	<b>11:52AM</b> 354:15,20	278:16,19
<b>11:06AM</b> 327:20,25 328:5,10	<b>11:53AM</b> 354:25 355:5,10	<b>16</b> 277:19 278:24 332:16
<b>11:07AM</b> 328:15,20,25	<b>11:54AM</b> 355:15,20,25	<b>16th</b> 254:17 257:5
<b>11:08AM</b> 329:5,10,15	<b>11:55AM</b> 356:5,10,15	<b>16,850,499</b> 332:17
<b>11:09AM</b> 329:20,25 330:5,10	<b>11:56AM</b> 356:20,25 357:5	<b>16.9</b> 333:7,12,14,24 334:8
<b>11:10AM</b> 330:15,20,25 331:5	<b>11:57AM</b> 357:10,15,20,25	<b>17</b> 287:21 290:10 360:3
<b>11:11AM</b> 331:10,15	<b>11:58AM</b> 358:5,10	<b>17.88</b> 313:5
<b>11:12</b> 331:16,17	<b>11:59AM</b> 358:15,20,25 359:5	<b>1974</b> 296:23 297:25 298:4
<b>11:18AM</b> 331:20	359:10	303:11 307:1 312:17 314:20
<b>11:19AM</b> 331:25 332:5,10	<b>114</b> 369:16	315:2 318:13 321:6,9
<b>11:20</b> 331:18,21	<b>12</b> 258:6,10 262:5 288:17,20	331:25 333:3,6
<b>11:20AM</b> 332:15,20,25	288:24 289:5,24 290:13,18	<b>1985</b> 303:11
<b>11:21AM</b> 333:5,10,15,20	293:5,7,11 330:11 341:23	<b>1987</b> 310:11
<b>11:22AM</b> 333:25 334:5	355:20 361:2	<b>1992</b> 303:11,12 310:11
<b>11:23AM</b> 334:10,15,20	<b>12:00PM</b> 359:15,20,25	<b>1997</b> 303:12 304:5 305:4,8,11
<b>11:24AM</b> 334:25 335:5,10	<b>12:01PM</b> 360:5,10,15,20	313:13,19 314:25,25 321:10
<b>11:25AM</b> 335:15,20,25 336:5	<b>12:02PM</b> 360:25 361:5,10,15	
<b>11:26AM</b> 336:10,15,20	<b>12:03PM</b> 361:20,25 362:10	<hr/> <b>2</b> <hr/>
<b>11:27AM</b> 336:25 337:5,10,15	<b>12:04PM</b> 362:15,20,25 363:5	<b>2</b> 268:7,17,19 277:20 309:19
<b>11:28AM</b> 337:20,25 338:5	<b>12:05PM</b> 363:10,15,20	316:24 318:4
<b>11:29AM</b> 338:10,15,20,25	<b>12:06PM</b> 363:25 364:5,10	<b>2.31</b> 313:22
339:5	<b>12:07PM</b> 364:15,20,25	<b>20</b> 329:2,2,17,22 330:2,23
<b>11:30AM</b> 339:10,15,20	<b>12:08PM</b> 365:5,10,15,20	331:6 332:13 334:14,18,22
<b>11:31AM</b> 339:25 340:5,10,15	<b>12:10</b> 365:20,21	<b>20th</b> 369:22
<b>11:32AM</b> 340:20,25 341:5	<b>12:15PM</b> 365:25	<b>2000</b> 255:18 343:11
<b>11:33AM</b> 341:10,15,20	<b>12:16PM</b> 366:5,10	<b>2002</b> 303:12 304:5 312:1

313:10,20 314:7 319:22 320:1 321:10 <b>2004</b> 305:20 318:11 357:24 <b>2005</b> 343:11 <b>2006</b> 343:7 <b>2007</b> 307:1 316:12 318:13 321:6,9 333:3 343:7 <b>2008</b> 332:1 <b>2009</b> 254:18 257:5 368:9,18 369:23 <b>221</b> 255:15 <b>221,114</b> 317:6 <b>225,114</b> 305:19 316:8 317:9 318:9 <b>23</b> 332:22 333:20 <b>23059</b> 255:18 <b>25</b> 270:14 278:12 <b>257</b> 256:5 <b>26</b> 342:16 343:5 <b>27</b> 342:17 <b>281</b> 287:7 <b>283</b> 286:5 <b>284</b> 286:5 287:7 <b>29</b> 346:25 <b>292</b> 269:14 286:18 <b>295,114</b> 305:18 316:13 318:11 319:24	<b>370</b> 256:7 <b>386</b> 369:24 <b>39225</b> 255:19	<b>7</b>
	<b>4</b>	<b>7-11D</b> 258:9 <b>7.6</b> 313:15 <b>70</b> 333:25 334:9,11,18 <b>700</b> 255:12 <b>72701</b> 255:15 <b>74</b> 311:13 <b>74103</b> 255:8,12 <b>74119</b> 255:5 <b>75</b> 271:17 334:11
		<b>8</b>
		<b>8</b> 262:18 329:13 333:5 <b>8A</b> 262:4 <b>8,017,422</b> 318:14 <b>8,453,057</b> 319:25 <b>8.8</b> 313:5 <b>80</b> 259:24 271:20,21,24 <b>81,086</b> 322:4 <b>85</b> 311:14 312:17 <b>87</b> 311:15
		<b>9</b>
		<b>9</b> 278:25 <b>9,659,093</b> 319:9 <b>9.6</b> 319:14 <b>9:05</b> 257:2,5 <b>92</b> 311:15 <b>94</b> 270:1 <b>97</b> 314:7
<b>3</b>	<b>5th</b> 255:7 <b>50</b> 259:25 <b>502</b> 255:4 <b>505,515</b> 332:7 <b>51,984,263</b> 312:9 <b>55</b> 270:4 <b>590</b> 261:10,17 269:12,16	
	<b>6</b>	
<b>3</b> 268:17,17 278:5,22 319:10 319:20 321:5 <b>30</b> 349:3 <b>30,000-foot</b> 293:10 <b>300</b> 268:25 269:18 277:25 348:3 <b>300-pound</b> 269:6 <b>32</b> 267:25 268:5 351:19 <b>320</b> 255:11 <b>33</b> 355:24 358:2 <b>34</b> 332:22 333:22 <b>343,394</b> 331:25 <b>347,000</b> 305:17 <b>354,000</b> 305:17 316:7 317:1,6 317:8 319:8,21 <b>369</b> 256:6	<b>6</b> 271:15 278:22 328:9 351:20 352:6 353:14,21 354:6,20 354:23 358:7 <b>6th</b> 255:4 <b>60</b> 306:6,7,11,17 <b>63</b> 352:24 <b>646</b> 268:9 <b>65</b> 264:17 267:15,22,24 297:6 298:10 320:6,9 328:1,4 330:2,10,23 331:7,24 332:11,15 333:4,22,22 334:1,4,10,12,18 347:6,9,14 347:20 348:10,16,20 353:1 353:6,10	